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presents something to interest and instruct—some useful fact stated in concise terms—some important maxim or sentiment in religion, morality, law, or civil policy; so that the charge usually preferred against English Dictionaries, namely, that they furnish but *dry sort of reading*, will not apply to this Dictionary." It does not confine itself merely to giving the meanings of words, it gives also as a rule some account of the things to which words are applied. For instance, under the word *Steam-engine*, it does not stop short after defining it as "an engine worked by steam;" it gives a brief account of the principle, construction, and action of the steam-engine, some particulars regarding the various kinds of engines, and a succinct account of its history, and the article is illustrated by a pictorial representation of a condensing engine having explanatory references to all the principal parts. So also with regard to *Horse*. To say with Dr. Johnson that it is "a neighing quadruped used in war, and draught, and carriage" is to add nothing to any one's knowledge. But in this Dictionary a small article is devoted to the horse, giving some general and scientific particulars regarding the animal and its different breeds, accompanied by an engraving which explains at once graphically such terms as "crest," "withers," "pastern," &c.

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[Continued on p. 6.]

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Northern Africa and South-western Asia. It is about the size of a fox, and of a uniform deep brown or wine-red colour above, except two spots under either eye, and tufts of long black hair which terminate the ears—from which last characteristic it has its name. It possesses great strength and fierceness, and is sometimes used in the chase of the smaller quadrupeds and of the larger kinds of birds.

Caracara (kä-ra-kä'ra), *n.* [From its hoarse cry.] The popular name for the birds of the sub-family Polyborinæ, of the family Falconidæ. They are of considerable size, natives of South America, and are characterized by having the bill hooked at the tip only, the wings long, and the orbits, cheeks, and part of the throat more or less denuded of feathers.

Carack (kar'ak), *n.* [Fr. *caraque*, O.Fr. *carraque*, Sp. and Pg. *carraca*, It. *caracca*, a carack, from L.L. *carraca, carrica*, a ship of burden, from L. *carrus*, a car.] A name formerly given to large round-built vessels of great depth, fitted for fight as well as burden, such as were used by the Portuguese and Spaniards in trading with America and the East Indies.

Caracol (kar'a-kōl), *n.* See CARACOLE, 2.

Caracol (kar'a-kol), *n.* A caracora (which see).

Caracole (kar'a-kōl), *n.* [Fr., from Sp. and Pg. *caracol*, a snail with a spiral shell, a winding staircase, a caracole.] 1. In the *manege*, a semi-round or half-turn which a horseman makes, either to the right or left. 2. In *arch.* a spiral staircase.

Caracole (kar'a-kōl), *v.i.* pret. & pp. *caracoled*; ppr. *caracoling*. To move in a caracole; to wheel.

> Prince John *caracoled* within the lists at the head of his jovial party. *Sir W. Scott.*

Caracoly, Caracoli (kar'a-kol-i), *n.* An alloy of gold, silver, and copper, of which an inferior kind of jewelry is made.

Caracora (kar-a-kō'ra), *n.* [Malay word.] A proa of Borneo, Ternate, and other Eastern islands. Also called *Caracol* by early voyagers.

Caradoc Sandstone (kar'a-dok sand'stōn), *n.* In geol. the upper division of the lower [illegible] and sometimes quartzose grits and limestones containing corals, mollusca, and trilobites. The Bala limestones are a portion of this group. The division is named after the hilly range of *Caer Caradoc* in Shropshire.

Caranx (kā'rangks), *n.* A genus of acanthopterygian fishes, family Scomberidæ. One species (*C. Trachurus*) on the British coast is well known by the name of scad or horse-mackerel.

Carapa (kar'a-pa), *n.* [From *caraipe*, the native name of the Guiana species.] A genus of tropical plants, nat. order Meliaceæ. A South American species, *C. guianensis*, is a fine large tree, whose bark is in repute as a febrifuge. Oil made from its seeds (called carap-oil or crab-oil) is used for lamps, and masts of ships are made from its trunk. The wood is called crab-wood. The oil of the African species, *C. guineensis*, called Coondi, Kundah, or Tallicoona oil, is used by the negroes for making soap and anointing their bodies, its taste being so bitter that it serves as a defence against bites of reptiles. The oil of the South American carapa is used for the same purpose also.

Carapace (kar'a-pās), *n.* [Fr., from Catalan Sp. *carabasca*, a gourd. See CALABASH.] The shell which protects the body of chelonian reptiles, as the tortoise or turtle. The term is also applied to the covering of the anterior superior surface of the crustaceans.

Carapax (kar'a-paks), *n.* Same as *Carapace*.

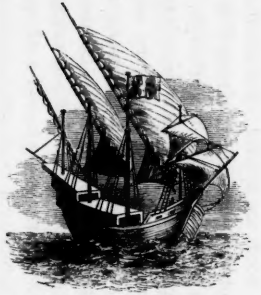
Carap-oil (kar'ap-oil), *n.* Oil obtained from *Carapa guianensis*. See CARAPA.

Carat (kar'at), *n.* [Fr. *carat*, Ar. *qirrāt*, a shell of a bean, a pea, a pod; also a weight of 4 grains, a carat, borrowed from Gr. *keration*, lit. a little horn, also the fruit or seed of the carob-tree, used for a weight, a carat.] 1. The weight of 4 grains, used by goldsmiths and jewellers in weighing precious stones and pearls.—2. A term used to express the proportionate fineness of gold. The whole mass of gold is divided into twenty-four equal parts, and it is called gold of so many carats as it contains twenty-fourth parts of pure metal. Thus if a mass contain twenty-two parts of pure gold out of every twenty-four it is gold of twenty-two *carats*.

Carauna (ka-ra'na), *n.* [Native name.] A resin produced by the tree *Bursera acuminata*, and imported from tropical America. It is brought home in little masses, rolled up in leaves of flags. It has an agreeable [illegible] Called also *Carana, Caranna*.

Caravan (kar'a-van), *n.* [From Fr. *caravane*, from Sp. *caravana*, Ar. *qairawān*, Per. *kārwān*, a caravan.] 1. A company of travellers, with a spacious court in the middle. Though caravansaries in the East serve in place of inns, there is this radical difference between them that, generally speaking, the traveller finds nothing in a caravansary for the use either of himself or his cattle. He must carry all his provisions and necessaries along with him. Those built in towns serve not only as inns, but contain shops, warehouses, and even exchanges.

Caravel, Carvel (kar'a-vel, kär'vel), *n.* [Sp. and It. *caravela*, a caravel, dim. of L. *carabus*, Gr. *karabos*, a light ship, a boat, also a crab.] *Naut.* the name of different kinds of vessels. One variety used in Portugal is a vessel of 100 to 150 tons burden, another is a fishing vessel of 10 to 15 tons, and a third a large Turkish ship of war.



Caravel of the fifteenth century.

The name was also given to a small ship used by the Spaniards and Portuguese in the fifteenth and sixteenth centuries for long voyages. It was narrow at the poop, wide at the bow, and carried a double tower at its stern and a single one at its bows. It had four masts and a bowsprit, and the principal sails were lateen sails. It was in command of three such caravels that [illegible] covered America.

Caraway (kar'a-wā), *n.* [Sp. *al-carahueya*, from Ar. *karwiyā, karawiyā*, caraway; probably from Gr. *karon*, L. *careum*, caraway. See CARVY.] 1. [illegible]

Caracora (kar-a-kō'ra), *n.* [Malay word.] A proa of Borneo, Ternate, and other Eastern islands. Also called *Caracol* by early voyagers.

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Carafe (ka-raf), *n.* [Fr.] A glass water-bottle or decanter.

Carageen, Caragheen (kar'a-gēn), *n.* [Ir.] A marine alga, *Chondrus crispus*. See CARRAGEEN.

Caragenine (kar'a-gen-in), *n.* Same as *Carrageenin*.

Caraite. Same as *Karaite*.

Carambola (ka-ram'bō-la), *n.* The native name of an East Indian fruit of the size and shape of a duck's egg, of an agreeable acidulous flavour, used in making sherbets, tarts, and preserves. It is the fruit of *Averrhoa Carambola*. See AVERRHOA.

Carambole (kă-ram-bōl'), *n.* [Fr.] In *billiards*, (*a*) the red ball placed on the mark. (*b*) A cannon (which see). (*c*) The name of the game in which the third or red ball is used.

Carambole† (kă-ram-bōl'), *v.i.* In *billiards*, to cannon.

Caramel (kar'a-mel), *n.* [Fr. *caramel*, caramel; Sp. *caramelo*, a lozenge—Ar. *kora*, a ball, and *mochalla*, a sweetmeat.] Anhydrous or burnt sugar, a product of the action of heat upon sugar. When cane-sugar is heated in an oil or metal bath to between 210° and 220° C., it begins to assume a brown colour of continually increasing depth, and when the tumefaction has ceased the vessel contains a black substance to which the name of caramel has been given. It has a high lustre, like anthracite, and dissolves readily in water, giving it a fine sepia tint. Its composition is the same as cane-sugar in its compound with oxide of lead. It is used for giving a brown colour to spirits. Written also, but less frequently *Caromel*.

Caramote (kar'a-mōt), *n.* [Fr.] A rather large species of shrimp (*Penæus caramote*) common in the Mediterranean, where it is caught in great numbers and salted for exportation.

Carana, Caranna (ka-ran'a), *n.* See CARAUNA.

two *carats*.

Carauna (ka-ra'na), *n.* [Native name.] A resin produced by the tree *Bursera acuminata*, and imported from tropical America. It is brought home in little masses, rolled up in leaves of flags. It has an agreeable

Called also *Carana*, *Caranna*.

Caravan (kar'a-van), *n.* [From Fr. *caravane*, from Sp. *caravana*, Ar. *qairawân*, Per. *kârwân*, a caravan.] 1. A company of travellers, pilgrims, or merchants, who associate together in many parts of Asia and Africa that they may travel with greater security, especially through deserts or regions infested by robbers. 'Men who pass in troop or *caravan*.' *Milton*.—2. A large close carriage on springs for conveying travelling exhibitions from place to place; a covered travelling cart without springs.

He had never seen such a fat boy in or out of a travelling *caravan*. *Dickens*.

3.† A number of vessels or barks in company.—4.† An expedition with such vessels.

Their galleys still spread over the Levant and came back victorious from their *caravans*, as their cruises against the Moslems were called. *Prescott*.

Caravaneer (kar'a-van-ēr'), *n.* The person who leads the camels, &c., of a caravan.

Caravansary, Caravansera (kar-a-van'-

Interior of Caravansary at Aleppo.

sa-ri, kar-a-van'se-ra), *n.* [Per. *kârwân*, a caravan, and *sarâi*, an inn.] In the East, a place appointed for receiving and lodging caravans; a kind of inn where the caravans rest at night, being a large square building,

long voyages. It was narrow at the poop, wide at the bow, and carried a double tower at its stern and a single one at its bows. It had four masts and a bowsprit, and the principal sails were lateen sails. It was in command of three such caravels that

Caraway (kar'a-wā), *n.* [Sp. *al-carahueya*, from Ar. *karwiyâ*, *karawiyâ*, caraway; probably from Gr. *karon*, L. *careum*, caraway. See CARVY.] 1. *Carum Carui*, nat. order Umbelliferæ, a biennial plant, with a taper root like a parsnip, which, when young, is used like carrots or parsnips, but it has a strong flavour. The seeds, which are properly the fruit, have an aromatic smell and a warm pungent taste. They are used to flavour cakes, also in comfits, and the volatile oil is obtained by distilling them in spirits.—2. A kind of sweetmeat containing caraway seeds. *Shak.*—3. A kind of apple. *Mason*.

Caraway-comfit (kar'a-wā-kum'fit), *n.* A sweetmeat containing caraway.

Carbamide (kär'ba-mid), *n.* [*Carbon* and *amide*.] A compound having the formula CH_4N_2O. It is obtained by the action of ammonia on oxychloride of carbon. This substance seems to be identical with urea.

Carbazotate (kär-baz'ō-tāt), *n.* A salt formed by the union of carbazotic acid with a base.

Carbazotic Acid (kär-ba-zot'ik as'id), *n.* ($C_6H_3N_3O_7$.) [*Carbon* and *azote*.] A crystallizable acid and bitter substance, obtained by the action of nitric acid on indigo and some other animal and vegetable substances. It is of great importance in dyeing. When silk, which has been treated with a mordant of alum or cream of tartar, is immersed in a solution of this acid, it is dyed of a beautiful permanent yellow colour. Often called *Picric Acid*.

Carbide (kär'bid), *n.* A compound of carbon with a metal, the usual effect of which is to render it hard and brittle. Formerly called *Carburet*.

Carbine, *n.* See CARABINE.

Carbineer (kär-bin-ēr'), *n.* See CARABINEER.

Carbohydrate (kär'bō-hī-drāt), *n.* [*Carbon* and *hydrate*.] An organic compound containing carbon and the elements of water, such as starch and cellulose. *Ure*.

Carbo-hydrogen (kär'bō-hī-drō-jen), *n.* Same as *Hydro-carbon*.

Carbolic Acid (kär-bol'ik as'id), *n.* [*Carbon*

Etymology. This section of an English Dictionary, while always esteemed important and instructive, has in these times derived new interest from the well-known fact that the science of comparative philology has made immense strides during the last twenty years, and that investigations into the philology and history of the English language and other kindred tongues, have enabled a much greater amount of certainty to be attained regarding the origin and affinities of English words than was previously possible. The ETYMOLOGY in this new edition has, therefore, been ALTOGETHER REMODELLED and brought up to the present state of knowledge on the subject, full use having been made of the labours of both English and Foreign philologists and etymologists. In dealing with this important department of the Dictionary the aim has been to state in a concise form such facts regarding the derivations of the various words as might suffice to meet the wants of the general reader, and to avoid such extended treatment as could only be appreciated by persons having a special knowledge of philology.

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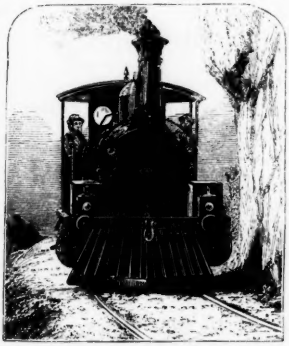
Dogger.—Dogger of Holland.

Ambulance Wagon.—British army.

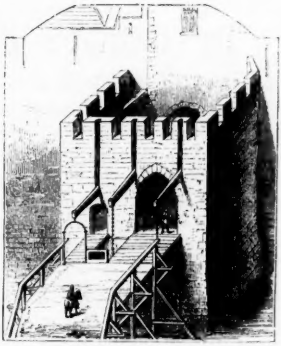
Armour, Mediæval.—Names of the parts.

Altar.—Church of St. Waudru, Mons.

Doublet, time of Edward IV. and of Elizabeth.



Cow-catcher.—Locomotive with Cow-catcher.



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I. WEATHER-WISDOM AND THE HARVEST.

DISMISSING as incurable the fanatics who sought a political cause for the series of bad seasons from which we have suffered, we come to a band of meteorologists, professional and amateur, who have latterly been prophesying smooth things concerning the weather and the crops. A wet cycle, we were told, was just coming to an end, and a dry one was beginning, the comparatively favourable harvest-time of 1880 being its forerunner. The present year was to be a repetition of 1868, and when, after a spring dry, but marked by an unusual amount of cold, blighting, northerly winds, a brief wave of high temperature passed over these islands, an excellent harvest was considered as guaranteed. Never was there a more typical illustration of the folly of counting chickens before they are hatched. The critical month, August, has proved exceptionally ungenial,—cold, wet, and boisterous to a degree bordering upon that of "cruel 1879." Thus we see that a dry cycle, if such has actually set in, does not necessarily involve a good harvest. We have had abundance of dry weather when rain would have been more useful, and now the wet has come when drought was needed. We see, further, another illustration of the simple rule that after an exceptionally severe and prolonged winter, such as the past, it is useless to expect a really fine, warm summer.

But before we form the conclusion that the seasons are deteriorating, or that a new "Glacial epoch" is approaching, it will be well to look back to former years. Before us lies a tabular record of the weather, collected by Mr. Glaisher, and taken from the "Farmer's Almanack" for 1880.

These returns extend over the thirty-two years from 1771 to 1803, and present a dismal picture. One summer only is pronounced "fine," and two "moderately fine," but with the drawback of a cold July. We see therefore that the probability of a season cold, wet, or both, during the months of June, July, and August, is something like ten to one. It must not be understood that in the twenty-nine years the whole of the summer was bad. Sometimes a fine June and July favoured the haymakers, and were then succeeded by a wet August and September, to the ruin of the wheat and the barley. Sometimes the case was inverted. But, we repeat, the probability of a preponderance of warm, dry weather from the beginning of hay-time to the end of the wheat-harvest is about as one to ten! The amount of damage varies of course greatly. It may in a moderate season not exceed a couple of millions sterling. In such a year as 1879 it is doubtful if sixty millions would cover the loss. This, we submit, is a matter of the deepest national concern. Should we not be profuse in our gratitude to a statesman who could contrive to reduce the national expenditure by even the smaller of these two sums? We are aware that certain hasty—not to say careless—observers are given to pooh-pooh the agricultural prosperity of the home kingdoms. "If our own harvest fails," say they, "we can import corn from abroad." But as more than half of the national capital is invested in agriculture it is surely of importance to us all if this capital, instead of bringing in a fair return, is diminished by yearly losses. That for the last few seasons this must have been the case appears but too clearly. We have all, therefore, to ask most earnestly whether there is no means of stopping this drain on national resources? One part of the mischief is, speaking in accordance with the present state of human knowledge, irremediable. We cannot secure calm, sunny weather while the wheat is in bloom; we cannot turn on hot weather to secure thorough and early ripening; nor can we banish the storms which lay both hay and corn prostrate. But over the last and most critical point in the career of our crops we have—thanks to a modern invention—an almost perfect power. In fact, to be practically independent of the effects of rainy weather during hay-time and harvest is now entirely within our own option.

For a better understanding of the case we must ask the reader to accompany us to a meadow about the end of June. When the grass has reached full maturity it is cut, and then—if there has been overhead a bright sun in a "glorious midsummer sky," the dew-point well below the temperature,

and a gentle wind blowing—the grass is speedily converted into hay, either by hand-labour, or, as is now often done on large farms, by dint of a hay-making machine. The third day, sometimes even the second, sees the grass thoroughly dried and ready for stacking. Under such favourable circumstances no improvement is needful. But such model weather is the rare exception; generally there are drawbacks. There may have been a downpour of rain before mowing, so that the grass and the ground are alike soaked; or the sky may be overcast and the air saturated with moisture, the dew-point being nearly up to temperature. In such cases the grass dries slowly, even in the absence of rain. Day after day it has to be turned over and tossed about, so as to expose fresh surfaces to the air and allow its moisture to escape. But too often rain falls before all this work is at an end. The grass becomes wetted afresh, and the process of drying has to be recommenced almost from the beginning, sometimes twice or thrice. We must endeavour to realise what all this means to the farmer. For hay-making he has generally to hire a number of extra men. Every additional day which passes over before the hay can be safely stacked is of course a direct addition to his outlay. Further, the value of the hay, whether for sale or for home consumption, rapidly declines. Hay, like most vegetable products, contains much matter soluble in water, and on this matter its nutritive value greatly depends. Every drenching, as it lies cut in the fields, dissolves out a portion of its soluble constituents. Decomposition sets in; its natural fragrance is destroyed, and is succeeded by a musty smell unpalatable to cattle. The final result not unfrequently is that it is not worth getting in at all, or can be used merely for litter. We can thus understand the anxiety of the farmer when he finds that a crop which should have been worth £4 to £5 per load turns out utterly valueless after having cost him perhaps upwards of 20*s.* per acre in attempts to save it. We think he may be excused for that grumbling in which he is commonly supposed to indulge more heartily than the rest of his countrymen.

Bad weather in harvest-time does not, of course, require extra labour for tossing the corn about; but the sheaves may have to stand for weeks in the fields, the in-gathering being delayed, and the quality and market-price of the grain being seriously affected.

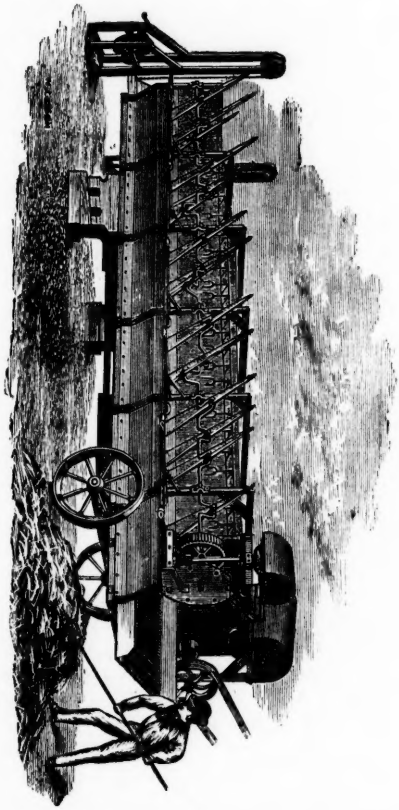
It will surely require no further demonstration that a contrivance which reduces the saving of the hay and corn crops in all seasons to a dead certainty, without the usual

deterioration of quality and increase of expense, must be of truly national importance. Such a contrivance exists, not as a matter of surmise, or probability, but as proved by practical work on a large scale before men not accustomed to wax enthusiastic concerning any novelty placed before them.

It is now twenty-one years since Mr. W. A. Gibbs, of Gillwell Park, Essex, first turned his attention to the subject, and succeeded in devising his drying-machine. Its essential feature is that hot air and the products of the combustion of coke or anthracite, as coming from a portable furnace, are driven by means of a fan right over and through the hay, corn, or other products to be dried. No one will, of course, doubt the superior economy of this direct method of applying heat as compared with kilns and stoves; but it might be supposed, on *à priori* grounds, that the gases of combustion —including, of course, sulphurous acid—would injure the flavour of the hay or other products. This is in practice found not to be the case. The machine-dried hay retains its full natural odour and savour, and is eagerly eaten by the most fastidious cows and horses; animals which are often found much more dainty about the quality of their food than an outsider would suppose. It is curious that the mustiness of an ill-made damp hay is completely removed by this treatment. Of the purifying power of the hot blast we personally witnessed a most surprising instance. Some time ago the south-western corner of Essex was much disturbed by the operations of an incendiary. A farmer in Sewardstone, about a mile from Gillwell Park, had had his stacks fired. The fire was indeed quenched, but the residue of the hay was completely soaked through with the torrents of water which had been dashed upon it, and was besides tainted with the smell of smoke. Cattle refused to touch it. We saw this damp, ill-smelling mass, apparently fit for nothing but to be thrown upon the manure-heap, put into the machine, and come out not merely dry, but freed from all empyreumatic smell. It was then readily eaten by cows and horses. We could not have conceived that the odour of burning, which every one knows is very persistent, could have been so simply and rapidly removed.

There is another conceivable objection, which caused the inventor himself to hesitate in the beginning of his experiments, but which has in actual working been found groundless—to wit, the danger of fire. It might be supposed that when the products of combustion are driven through a mass of hay, a spark might easily set the whole on fire. It must

be remembered, however, that the grass is fed into that part of the machine which receives the hot air directly from the furnace, and as it becomes drier it travels gradually on to the cooler parts of the machine. (See drawing.) Hence if a spark flies up from the burning fuel it is at once extinguished by the green matter with which it comes in contact, and



which thus protects the drier portions. In practical working no disaster from this or any other cause has ever arisen.

But this primary principle, the passage of the furnace products through the hay itself, would have been very inefficient without the mechanical arrangements by which the

material to be dried is automatically lifted up, tossed, and shaken in the current of hot air, and gradually passed on from the furnace end of the machine to the outlet end. This task is executed, as will be seen on reference to the illustration, by a series of tines fixed on cranks, and imitating simply, but most successfully, the action of the arm of the haymaker as he lifts up and spreads a portion of hay with his fork. It is an important point that this machinery though highly ingenious and to appearance delicate, is liable to get out of order.

The advantages of this process of machine-drying are very striking. Time and labour are saved to such an extent that the farmer will be able to get in his crops with his ordinary staff of labourers, and without the necessity of employing gangs of strangers, who are often careless, disorderly, and untrustworthy. So speedy is the action of the machine that at Neston Park, Wilts, the seat of G. P. Fuller, Esq., 30 tons of hay were made in twenty-three hours, at 13*s.* 6*d.* per ton, including the cost of mowing and stacking, though rain was falling frequently. In a second trial 33 acres were cleared in twenty hours, at a rather less cost, the bailiff in charge expressing the opinion that it will pay to use the machine even in fine weather. At Kimbolton Castle 7 acres of a heavy crop of clover were dried in seven hours by men who had had no experience with the machine at all. On Lord Ashburton's farm at Alresford, 19 acres of water meadow-grass were dried at 10*s.* 6*d.* per acre; whilst in an adjoining meadow a farmer cut his grass on July 15th, and after working at it by hand-labour till August 11th found it all spoilt. At Haarlem, on the farm of M. Amersfoordt, grass that had been cut for two days was made into hay *in five minutes*, and could be stacked with perfect safety. It must be remembered that the economy of labour, and the rapid withdrawal of the crop from the chance of damage by floods, &c., is not the whole of the benefit. The improvement in quality is most striking. Some time back, before the practical results of the drying-machine became known, Prof. Voelcker, F.R.S., expressed the following opinion in the "Transactions of the Royal Agricultural Society:"—"If hay could be made rapidly, without exposure to the sun's rays and the evening dews, it would contain much more nutrition than now." That this opinion applies to the machine-made hay is plain. It is of a bright green colour, of a stronger fragrance than ordinary air-dried hay, and is evidently preferred by all kinds of stock. Mr. Fuller wrote only a few days ago to the effect that twenty steers have

improved rapidly in condition since they were fed upon the machine-hay.

We have already referred to the fact that hay may now be saved in a sound condition which would otherwise have been spoiled and wasted. On this point it is interesting to hear the testimony of practical men. Mr. Roddick, of Quintain Hill, Waltham Abbey, says:—"Nineteen loads of damaged hay, which would otherwise have been useless, were rendered fit for stacking at the rate of 2½ loads per hour. I realised £60 to £70 by the day-and-half's use of the Hay-dryer." Mr. Mills says:—"Heavy, wet hay, black with decay and dust, came out a good, fair colour; the horses ate it freely. I estimate it as worth £5 a load in market, and have saved £20 by the half-day's work." Here, again, there may be something more than meets the eye. Damp, mouldy, ill-made or ill-kept hay has been recognised as unwholesome food for cattle. Now the moulds are minute plants, some of which are known to have a very injurious action if introduced into the animal system. The spores or germs of these moulds, and of other low organisms, are known to be present in the air and to attach themselves to grass. Hence men of science who have experimented on so-called "abiogenesis," or spontaneous generation, and those who have made microscopic organisms their study, have often selected infusions of hay as a material to work upon.

Now it strikes us as far from improbable that the machine-drying process, involving as it does exposure to a considerable heat in a current of carbonic and sulphurous acids, might prove fatal to many of these germs, and might thus contribute to the good health of stock and their preservation from epizootics, entozoa, &c. This point is, we think, not unworthy of experimental investigation.

So far we have given our attention exclusively to hay-drying. But the same principle, with certain alterations in mechanical details, is equally applicable to corn of all kinds, to seeds, coffee, tea, megass, malt, hops, and a variety of agricultural products. Thus for wheat the current of hot air is forced in below the false bottom of a sheet-iron chamber. From the false bottom there arise conical tubes, upon which the sheaves are fixed. A current of hot air is thus delivered up the centre of each sheaf, and, forcing its way out in all directions, rapidly dries both grain and straw. Peas, beans, &c., when dried by this process, retain, as may be expected, much more of their natural flavour than when air-dried. Peas especially may be kept for months, and when soaked and boiled taste as if freshly gathered. For

perfume-plants, pot-herbs, &c., the "Gillwell Dryer" has a future before it. The only decided failure which Mr. Gibbs has hitherto encountered has been in the attempt to convert grapes into raisins.

The least satisfactory feature connected with this invention has been the sluggishness of the public to accept the benefits offered. That the practical application of the principle to all the various conditions of the question did not suggest itself to the inventor in a moment may well be believed. To our personal knowledge Mr. Gibbs has devoted twenty of the best years of his life to perfecting his machine, simplifying its movements, and reducing the cost of construction. Those who know the expense of mechanical experimentation will feel little surprised if told that he has expended not less than £10,000 upon this his life-task. The Society of Arts awarded him their gold medal and 50 guineas in the very outset of his researches. The Highland and Agricultural Society of Scotland paid a similar tribute to his merit. The Press has given him its support, and not a few noblemen and gentlemen—we may mention the Dukes of Northumberland and Manchester, Lord Ashburton, and some of the leading landowners in many different counties—have adopted the Dryer, and expressed their unqualified satisfaction. But the great mass of the agricultural interest —landlords as well as tenant-farmers—still hold aloof, and allow their crops to perish, season after season, with an apathy that is rather ridiculous than sublime. That the inventor will yet be recognised as a great national benefactor, of more value to mankind than a score of orators and agitators, is certain; but the long delay is poor encouragement for inventors,

The agricultural interest has no cause to despair. Mr. Prout has shown them how wheat may be grown so as to pay, foreign competition notwithstanding; and Mr. W. A. Gibbs has taught them how their crops may be safely gathered in, in spite of unfavourable weather. Will they accept the lesson?

II. A GEOLOGICAL IDEA OF LORD BACON'S.

By Dr. O. REICHENBACH.

(Concluded from page 533.)

THE soutnern ends of the three prototypic segments in Ps were not all moved away from Ps. The reflux of the excess of water round Ps tending in the deep towards the most attracting meridian, Pr of the nucleus traversed it with increased velocity, and produced gradually the greatest condensation and pressure of the envelope, and therefore the greatest accumulation of water round Ps V and its flow in the direction V Pr, to the point of greatest gravity in the equator. The opposite preflux from west to east, through the interval in the south of segment Pr, developed itself superficially by reaction. Segment Pr was therefore not only moved north; its portion south of 55° 8′ was moved towards Ps and beyond, and is divided into two sub-sections, of which the long axis extends through 46°56′ + 3°52′, the diameter of the polar circle plus a northern reaction wave.

This end of segment Pr, cut off in 55° 48′ S. lat., is all the Antarctic land there is. The segments Ap and Af have been wholly moved away from Ps by the reflux developing itself from the direction of segment Pr, south of 55° 48′ S. lat. on to long. 90° E. or meridian Af, with increasing velocity, and with a quantity regionally massed by the advance of the Antarctic land over Ps towards Ap.

The 1-11·56 of segment Pr thus cut off is less than 1-29·78 of all land, as 1 : 1·08, which should be the equivalent of elastic reaction north to south generated in the interstratum by heat produced through the falling advance of 1-29·78 of all the sea from south to north.

Suppose the south polar zone all sea, and plunge into it with Ps as centre a disk equal to 1·29·78 of all land; the disk has a radius of 10° 44′, and a series of oscillations of this width will arise in the sea all round, reacted upon and modified by oscillations 3° 52′ wide, over-reaching from the other hemisphere: 3° 52′ are to 10° 44′ as 1 : 2·73 as all southern to all northern land. We thus have modifications of the—

$$\frac{90^\circ - 3^\circ\,52'}{2\cdot83^2} = 10^\circ\,44' \text{ to } \frac{90^\circ}{2\cdot83^2} = 11^\circ\,8' \text{ and } \frac{90^\circ + 3^\circ\,52'}{2\cdot83^2} = 11\cdot35'$$

represented by peninsulas, isthmuses, islands, mountains: $2{\cdot}83^2$ is the extreme division of land in opposite hemispheres, and the proportion of the number of vibrations of their respective land masses, as shown by the comparison with blades. I exclude details about the difference between 2·83 and 2·73.

The height of a zone occupied by all land past from south to north, or in excess at the north, over one-half of all land, is $1\text{-}2{\cdot}83^2$ of the radius; what connects sphere and blades?

South America 10° 44′ from the antarctic circle has been moved and stretched 10° 44′ north of the equator; in the extremely tertiary reaction to 11° 35′. The triangle at its south reaching to the mouth of the La Plata, opposite the southern end of Africa, has been kept in a prototypic position by the reflux, its pressure being unimpeded below Africa. The northern end of the section has been widened from 31° 20′ in the equator to 46° 56′, the width of the tropics; the perturbation in longitude has increased with the increase of the polar arc and zone, with the separation and going apart in density of sea and envelope.

The long axis of the section and the bases from West Panama to Cape Horn are 66° 32′ as the arc from the polar circle to the equator. The east side is 55° 48′, the height between the equator and parallel of partition, because the triangle is pressed west, the northern side being by reaction from the north pressed south at its east, and north at its west, from the direction of V. The northern side, West Panama to La Roque, is 46° 56′.

The arc between the two Americas, at the east of the deutotype, is 46° 56′, the reflux halving the segment. At the west polar pressure has reduced the distance to 23° 28′. In this interval between the folds a tertiary perturbation has produced an island wave.

Trinidad, Cuba, Yucatan, which 10° 44′ north of the continent repeats its shape and its distance to the equator, is connected with the continent by an isthmus, the result of the combination of a perturbation in the reflux inclined 23° 28′ to the equator, with a perturbation in the polar stream or line of intensity, V, Pr, L.

The island wave and isthmus belong to the south section, and are, with its land north of the equator, equal to a polar section.

As the sea round Pn gets confined by the motion north of the segments, the region round Pn gets depressed, and the northern ends of the segments are moved south. Those of Ap and Af become truncated; the water pressing from Pr

towards L and beyond is thus reversed, at present chiefly from Obi and Lena, towards and beyond Pn, and circulates within the zone. Segment Pr has been thus not merely depressed from north to south, and moved toward S to the incline of 23° 28′ with meridian Pr, but its northern end has been cut off from west to east in proportion 1 : 4·78 to the middle section, as the southern end was cut off in the opposite direction. It became divided into islands. The normal latitude of partition 34° 20′ from Pn is indicated by 3° 52′ south of Cape Farewell by the junction of the waters flowing east and west of Greenland on their return towards the equator.

The more the segment increases in size and becomes inclined to the meridian, and the polar section itself increases, the more the latter gets similarly as at the south reversed in shape, the point south, the broad end north, until it penetrates like a wedge between the north middle section of Pr and the north section of Af.

The reflux dividing segment Pr is gradually raised to an angle of 34° 12′ − 3° 52′ (northern reaction) in the Gulf of Mexico by the projection north of South America, corresponding to the depression of the reflux south of Africa to 34° 12′ S. lat., and the land bulges out all along west of the line of intensity, S, Pr, towards the north.

The section reaches east of S by southern reaction 3° 52′ beyond the arctic circle. Thus reaches the Graham's group out of the antarctic circle, by reaction passing over Pn, Ap, and Ps; and the arctic section Greenland reaches 3° 52′ × 2 out of the arctic circle, pointing south, however shortened, a shortening for which volcanic Iceland is the equivalent.

The long axis of the south continent from near S to Cape Catorha and the basis S to Yucatan west inside Gulf are 66° 32′; the north and the east side are 46° 52′. From S to where the east side of the deutotype leaves the land we have 55° 48′.

The continent of the arctic section has a long axis of 23° 28′, and a peninsular prolongation of 3° 52′ at its north-east.

The Gulf of Mexico reaches 10° 44′ into the north section from the south; so does Hudson's Bay from the north, in reciprocity with the Siberian peninsula of Ap, reaching 10° 44′ into the arctic circle, and 180° of longitude distant. Hudson's Bay, with James Bay, reaches 10·44 + 3° 52′ from arctic circle to South Florida, meridian Pr equivalent of James Bay.

The apocentric segment is inclined 23° 28′ to meridian Ap;

at the north it coincides with segment Af to the extent of $\frac{1}{29{\cdot}78 \times 2{\cdot}83^2}$ of all land. It has for basis L, Ap, V; its east is at the north limited by M, Ap, I, as that of segment Pr is indicated by V, Pr, L. It joins all through the north of segment Af, which occupies the prototypic position, and ocean circulation so is barred, reversed, and interned.

The more segments Ap and Af were moved north, and the former advanced together with the coinciding portion of Ap and Af into the arctic circle, and the cut-off and transforming end of Pr moved south, the greater became the pressure of the intervening sea from west to east against the north of Af. The north of Ap was therefore more advanced west to east toward S than the north of Pr is advanced toward L. Ap had for leaving west only half the room of Pr,—90° of longitude against 180°.

This reciprocity increased the pressure from north to south; the southern reflux became compressed in the deep, in the direction V, and all through until it had got past the southern and northern section of Ap in going west, when it again gained room for an expansion which not only pushed the southern section of Af most of all to north, but also to west, in reciprocity of the motion of the north of Ap to east. Segment Af so retained its prototypic position, and the western part of its southern section bulged out towards the interval dividing the pericentric segment. The west of its north section, divided from the south section by an ocean basin attaining to 34° 12′ + 10° 44′ latitude for the mean (Genoa and Adriatic), was stretched out and pointed to west by the sea reversed from Pr (respectively Panama), and formed the triangle of that large continent into which it became united, with the north of segment Ap as oblong. Af, more compressed from south and north, became the shortest, widest, and highest of the three segments.

The southern points of the three continental masses divide longitude from segment Pr west to Ap, and back to Pr 1 : $\sqrt{2{\cdot}83}$, and from segment Af west to Pr, to remainder 1 : 2·83.

They also follow a regular progression in their distance from Pr. Segment Pr, freed from the antarctic land, is from Ps 23° 28′ + 10° 44′ = 34° 14′, leaving to the equator 55° 46′, the latitude of Cape Horn. Segment Ap should be from Ps 23° 28′ + (10° 44′ × 2) = 44° 56′, leaving 45° 4 to the equator, but Van Diemen's land reaches only to 43° 40′ S. lat.; the deficiency of 1° 24′ is at once corrected by New Zealand reaching beyond 45° 4′.

The middle segment should be $23^\circ 28' + (10^\circ 44' \times 3) = 55^\circ 40'$ from Ps, leaving $34^\circ 20'$ to the equator, 6′ more than the $34^\circ 14'$ from Ps to Cape Horn. Cape l'Agulhas reaches to $34^\circ 55'$, 35′ farther than $34^\circ 20'$; the difference is that between the $10^\circ 44'$ and $11^\circ 15'$, making up for the deficiency at Van Diemen's Land. The west of Beagle Channel, north of Cape Horn, is from Ps as far as Cape l'Agulhas is from the Equator; the divide longitude 1 : 2·73 as land south to north in reality. The parallel of partition is moved to 53° S. lat., the mean latitude of Magellan Straits when the surface between it and Ps shall represent the 1-29·78 of all land really moved north of the equator from the southern half of segment Pr.

1-4·19 of all land moved south to north by the ocean accumulated over a more condensed interior have produced the relative land south to north 1 : 2·83. Quantities changed by tertiary causes to 1-4·25 and 1 : 2·73.

The prototypic segments have been moved from Ps to 31° 20′ of longitude at the equator in front. (The longitude occupied by ocean within the $(31^\circ 20' \times 3) = 94^\circ$ of land formation in the equator is to the longitude of the actual land as $1 : (\sqrt{2}\cdot 83)^3$, and represents a tertiary perturbation, connected with perihelion position.)

The quantities moved are therefore indicated by the normal distances of the southern ends of segments from Ps, from which we afterwards have to deduct the quantities retained or transferred south by reaction from the north.

Segment Pr, initiating the transfer, had its polar end moved south towards and beyond Ps; it became reversed in form. Graham's Land points north as Greenland points south, and the first pointed end at Ps is now flattened between Ps and Ap.

Segment Pr moved from 55° 46′ to where it still stretches, north of the equator, with a surface not only equal to a trune 31° 20′ wide and 10° 44′ high, equal to the triangle between Ps and 55° 46′, the latitude of Cape Horn, but with a trune 11° 36′ high, and equal to 1-29·78 of all land, or to the triangle reaching from Ps to 53°, the mean latitude of Magellan Straits, the channel indicating the parallel of partition, as the land from Cape Horn to the Chupat River $23^\circ 28' + (10^\circ 44' \times 2)$ from Ps indicates the return by northern reaction of land equal to the difference between a polar land section and the 1-29·78 of all land, the real return being only 1-480 of all land, and the antarctic section being actually 1-480 of all land smaller, and the middle section so

much larger, as required by proportion 1 : 4·78. At the north the conditions are the same, but in different form.

For Ap the normal line of advance fell 44° 56′ from Ps into 45° 41′ S. lat ; the trune advanced north would be therefore 31° 20′ wide and 44° 56′ high.

For Af, closing the circuit, the trune passed north would be 31° 20′ wide and 55° 48′ high.

These three trunes, 11° 36′, 44° 56′, and 55° 48 high, represent 1-3·49 of all land. But as the land passes north, the ocean becoming confined in the extending arctic zone, and the excess weight of land pressing on the elastic substratum react increasingly from the land on the water hemisphere. The land retained and passed by reaction at and to the south is therefore equal to the land within the arctic zone, which is to that in and round the antarctic zone $\sqrt{2}\cdot83 : 1$. It is 1-20 = 1-12·08 (polar zone to sphere) − 1-29·78 of all land. It is to the land actually past north as $1 : (\sqrt{2}\cdot83)^3$ minus 1-480 of all land. It is when a, the land maintained south by reaction from the north, and b, the land actually passed north, $a : (a+b) - \frac{b}{47\cdot77}$ (by tertiary reaction) as $\sqrt{1\text{-}29\cdot78} : 1 = : 5\cdot47$. The ocean at the north is within a fire-warmer, waters having travelled from the north to the south in filters round Ps into the boiler below ; the inner envelope is heated by pressure and friction turned into steam and presses land lifting towards the north, warming the water passing at the north over the bottom of the sea. The land raising north to south is a counter-process. The figures 1 : 5·47 have a varied significance for the present life of the earth.

The 1-20 of all land retained at the south by northern reaction is, after deduction of 1-480 of all land returning to Pr, divided between Ap and Af in proportion $1 : (\sqrt{2}\cdot83)^3$.

All land of Pr south of the equator is therefore equal to half the segment, minus a trune 31° 20′ of longitude wide, with the equator as basis, and as high as the distance between the Antarctic circle and Cape Horn.

All the land south of the equator belonging to Af is equal in surface to the triangle between Ps and the parallel of Cape l'Agulhas, the southernmost point of the segment in 34° 55′ S. latitude.

The portion of segment Ap between Ps and Van Diemen's Land in 43° 40′ is equal to the Australian continent. The triangle between Ps and the south of this continent in 38° 40′ is equal to all land of segment Ap south of the equator.

The separation of the south section of Ap from Van

Diemen's Land in the south, New Guinea in the north, and New Zealand in the east (the latter by reaction from Africa), and of smaller islands, shows distinctly how land moved north has been by tertiary reaction cut off from the main section or continent, and how interference folds have been formed in the intervals through pressure from the north.

When we start from Pr at the equator, and the north shore of South America at its east, and proceed over Pn on the same circle to Ap, we find at its east an island wave which extends and points south 10° 44′ at South America, extends and points to 10° 44′ north, whose organisms present the characteristics of the Asiatic, northern section, and which separates from the southern section New Guinea and smaller islands whose organisms present either the Australian characteristics or a compound nature.

When we return over Ps, back to Pr and beyond, we find 10° 44′ north of the shore of South America the tertiary wave, Trinidad, Cuba, Yucatan, closing the circuit,—a wave which, with the supplementary isthmus south, is equal to all non-Australian land between the equator and continental Australia, and which, adding the volcanic south of Mexico, is equal to all land between the equator and Australia proper.

Segment Ap is divided not in four, but in two parts, in proportion $1 : (\sqrt{2}\cdot 83)^3 = 1 : 4\cdot 78$.

The middle segment is divided north to south 1 : 2·83 : it reverses, closing the circuit, the relation of the hemispheres. Subsections, and the contiguity of the north section with Ap, are here extensively to be considered.

The east limit of segment Ap, between the two continental sections, is like at Pr from South Carpentaria, 46° 56′; the west limit, south of Sumatra to Australia, 23° 28′. The east limit of the segment, north to the meridian dividing Af, is 66° 32′.

Ap stretches 10° 44′ into the arctic circle, and measures from Lunk Leylon to the north or meridian Ap 66° 32′.

The axis through the middle of the southern section of Af, on the meridian dividing all land and sea equally, is 66° 32′; that through the north section is 23° 28′, plus 3° 52′ in the arctic circle occupied by the coincidence of Af with Ap.

The readers of Mr. Russel Wallace's "Island Life" may observe the relation between my sections and the distribution of organisms. This relation becomes still more striking when subsections and the lines of intensity are considered. There exists an intimate relation between the distribution of gravity, and of consequent motions and oscillations of sea

and land, and their history with the past evolution and present distribution and condition of organisms.

In my theory the explanation of real and apparent changes of climate offers no difficulties. Climate has changed absolutely with the development and condensation of the solar system and of our earth. It has changed with the changing positions of the axis of the earth on its orbit,—that is, with the raising and permanency of continents and the distribution of sea and land, with the folding and unfolding of solid waves sliding, and with the whole envelope sliding in procession.

III. LATENT HEAT.

By Charles Morris.

SCIENTISTS have a somewhat misleading method of grouping together several widely different modes of motion under one name,—not to their own confusion, perhaps, but decidedly to that of unscientific readers. Thus, after singling out a few forms of force under special names, all the rest are massed together and called heat. It is true the special character of the force intended is indicated by adjectives. Thus we speak of Radiant Heat, Specific Heat, Latent Heat, Absolute Heat, and, simply, Heat. Of these the first phrase is most commonly used, and is most incorrect. It expresses a mode of motion which is essentially different from Heat motion. It is readily convertible into Heat, but so are Light and Electricity, and the simple word Radiance would perhaps be a better term for it.

The word Heat itself, in fact, does not express one single mode of motion, since the heat motions in solids and gases are very different in character, while there is reason to believe that liquids also possess a special mode of heat motion. So Specific Heat, Absolute Heat, and Latent Heat have special significations, which scientists have no difficulty in comprehending, so that the word Heat to them expresses far more than it does to well-informed unscientific readers. Of these various terms Latent Heat is the one least understood,

and some writers deny that the force condition which it indicates is in any proper sense allied to Heat, and claim that it should be expressed by some distinctive word.

Yet these writers have given no satisfactory hypothesis to the contrary, and it remains probable that Latent Heat is but a special modification of heat energy. I have already briefly given my views concerning it, in the April number of the Journal, but will here partly repeat them in order to deduce certain important and interesting consequences of the principle of Latent Heat.

Latent Heat, in its usual signification, is the heat which disappears when the solid is converted into the liquid, and the liquid into the gaseous form of matter, and which reappears in the reverse process. Yet it has a much wider significance than this, since these radical changes in the condition of matter are by no means necessary to its existence. Every apparent loss of heat in change of material condition is a conversion of sensible into latent heat. Thus as solids and liquids grow hotter their Specific Heat is said to increase. By this we mean that it takes more heat to produce a certain temperature effect at high than at low degrees of temperature. Part of the heat disappears, or becomes latent; or, in other words, it needs different volumes of heat motion to produce unit effects of temperature when matter is in different states, or in different temperatures of the same state. But this gives us no just reason to conclude either that motion has gone out of or come into existence, has changed into something that is not motion, or has lost its centrifugal and assumed centripetal relations. It may continue to exist as centrifugal motive energy, and fail to make its existence felt as vigorously in high as in low temperatures for some sufficient reason.

This reason, as considered in my article above referred to. may be a mere difference of resisting energy in the molecules of matter. The effect of a blow does not depend solely on the weight of the stick, but partly on the energy of the muscles which wield the stick. So a molecule which is strongly bound by attraction to other molecules, or vigorously wielded, as we may say, by other molecules, strikes a heavier blow than one which is weakly bound or feebly wielded. The first represents a moving stick with a strong arm behind it; the second, the same stick with a weak arm. The blow of the first receives much more exterior aid than that of the second, and is therefore more effective. To produce equal effects the stick wielded by the weak arm must have greater weight, or must have a more vigorous original motion of its

own than is possessed by the stick wielded by the strong arm. If it fails to receive equal energy from without, it must possess greater energy in itself. This is the whole secret of latent heat. Molecules are partly individuals and partly constituents of a more or less rigid whole. They are in incessant motion, and come into very frequent contact with each other. By equality of temperature we mean that these molecules strike each other with equal energy, and resist repulsion with equal energy. But for this equality of effect it is not necessary that their individual motive energies shall always be equal. For if they are parts of a rigid mass their strength of resistance comes only partly from themselves, partly from their fellows. But as the mass loses rigidity each molecule receives less and less aid from its fellows, and has to depend more and more on its individual vigour. Each molecule is attached by attraction to its neighbours, as if it occupied the centre of an elastic band whose ends were firmly fixed. The more rigid such a band, the less individual energy would be needed by the molecule to give it a unit vigour of resistance. The less rigid the band, the more individual energy would be requisite. Two molecules of equal weight strike each other with equal speed. Their momentums are equal, and they should recede with equal energy. But one of them is firmly held by links of attraction to surrounding molecules, while the other is but weakly held; therefore the first cannot recede without dragging a number of others with it, while the drag of the second is much less. Thus the receding energy of the first, being resisted through its rigid connection with many others, is much less than that of the second, which is less resisted. The first molecule imparts more energy to the second than it receives in return, or, in other words, the temperature effect of the first exceeds that of the second. The temperature effects of the two can only be equalised by giving the second more motive energy, or increasing its individual momentum. And this excess of motive energy is what we know as Latent Heat.

We have the whole mystery here. As attractive energy between the molecules diminishes, each of them needs more individual motive energy to give it equal resistance to impact. This applies to all the molecules of a mass, and therefore the whole mass needs more heat motion to produce unit temperature effects as its internal attractive vigour decreases. But the result of heating a solid mass is to decrease the vigour of attraction between its molecules. It expands with increase of temperature, and becomes less rigid. As a

consequence its specific heat increases, or a portion of its heat becomes latent, or, in the terms of this hypothesis, each molecule, and therefore the mass as a whole, needs more individual heat motion to give it a unit resistance to exterior heat impact.

When solids are far from their melting-point this effect is slight, as they decrease very slowly in rigidity. Thus it is inappreciable in platinum at ordinary temperatures, since this metal is then very far from its melting-point. But as solids approach their melting-points the increase in specific heat becomes declared. It is especially marked in those solids which soften before they melt, and it thus shows its relation to decreased rigidity. On melting there is a very considerable increase of specific heat, and particularly in those substances which continue rigid to the moment of melting. In passing from the last degree of solidity to the first degree of liquidity the specific heat suddenly becomes very great. But the rigidity very greatly decreases, so that the two effects continue in accordance. The molecules of the liquid have to depend far more on their individual energy than do those of the solid, and are thus obliged to absorb a considerable volume of motive energy to put them into temperature equilibrium with the solid.

The same rule holds with liquids as with solids. As they slowly expand with heat their internal attractive vigour decreases, and their specific heat increases. On changing to the gaseous state there is another sudden decrease of rigidity. The attractive control of molecule upon molecule very markedly decreases, and there is a sudden and enormous increase of specific heat in the degree of temperature leading from the liquid to the gas. The molecules have become strongly individualised, and need a great increase in motive energy to place them in temperature equilibrium with solids and liquids. The same principle holds good with gases. As their temperature rises above the point of vaporisation the attractive energy between their molecules probably continues to decrease, and their specific heat increases. When, however, their temperature is considerably above the point of vaporisation, the specific heat becomes constant. It is presumable that their rigidity has also become constant, as in solids when far below their melting-point.

This is latent heat in its ordinary acceptation. There is no real loss of heat energy, and no transfer of motive vigour from the centrifugal to the centripetal field. All the heat energy received continues to be energy of molecular impact, and it increases in relative amount to the exact degree that

resistance to impact decreases in energy, through molecules being more and more obliged to depend on their individual motive powers, and less on assistance from their neighbours.

But latent heat presents other phenomena, which it is necessary now to consider. Thus we find the specific heats of solids and gases are closely similar, while the specific heat of liquids is considerably greater than that of either solid or gas. How is this to be explained? Must we consider that liquids decrease more rapidly in rigidity with increased heat, or can we conceive of any other cause? The first explanation is hardly probable, and it may not be difficult to deduce a better one. It seems more probable that this behaviour towards specific heat of the three forms of matter points to a certain similarity in motive condition between solids and gases, and a diversity in liquids. That the conditions of heat impact in solids and gases have a strong similarity we are well assured. In both cases it is direct impact of molecule upon molecule, these being free moving molecules in the gas and vibrating molecules in the solid. But it is very doubtful if this condition of direct impact exists in the liquid. If, as the writer is disposed to consider, the liquid state of matter consists in rotation around a centre of attraction, instead of a vibration between local attractions as in the solid, its motive energy becomes to some degree centripetal. Rotating particles could not meet the impact energy of solid and gaseous particles by a reverse impact, and their resistance must partake of the nature of elasticity. They must retain their curves of rotation with a degree of inertia, whose vigour depends on the energy of central attraction, and must thus oppose an elastic resistance to the impact energy of exterior molecules. But the rate of decrease or increase with temperature of an energy of this kind might be very different from that of impact energy, and thus the specific heat be very different. In the illustration already given of a molecule attached to the centre of an elastic band, we would have, in the molecule of the solid, the double resistance of the elasticity of the band and of its own moving energy; in the liquid molecule the elasticity of the band only, since here the moving energy virtually converts the molecule into such a band. Possibly, then, the resistance of the molecules of the liquid would decrease more rapidly than that of the molecules of the solid and the gas, and its specific heat would be greater in consequence. The heat energy, which is a centrifugal motion in the solid and the gas, may become partly or wholly a centripetal motion in the liquid.

But our review of latent heat by no means stops here.

There are other instances of great increase and decrease of attractive energy to be considered. Thus chemical integration produces an immediate and great increase of attractive vigour between particles. There is, therefore, a marked increase in resisting vigour, and much less heat is needed to yield unit effects of temperature. The excess heat of the compound flows out as active heat energy. It is no longer needed by the combining particles, and becomes effective elsewhere. In chemical disintegration this effect is reversed. There is a marked loss of attractive vigour between the separating particles. They become greatly individualised, and must absorb considerable motive energy from without to bring them into temperature equilibrium with surrounding matter. Or, in the usual phraseology, in chemical integration much latent heat becomes sensible; in chemical disintegration much sensible heat becomes latent.

There remains one other phenomenon of latent heat to be considered. We have so far viewed the latency of heat as a result of decreased internal resistance, arising from the gradual or sudden decrease of attractive energy between molecules. But a like effect may arise from another cause, that of increase or decrease of external pressure. This action, while of little effect upon solids and liquids, is very effective upon gases, and causes marked changes in their heat contents. If gases be greatly compressed a considerable volume of their latent heat becomes sensible. If they be greatly expanded a considerable volume of their sensible heat becomes latent. In the first case their temperature markedly rises; in the second it as markedly falls. The result here seen is in strict accordance with the principle above enunciated. The compression of a cubic foot of air into a cubic inch of space may not necessarily increase the vigour of attraction between its molecules, but it must increase the effective energy of these molecules. The surface against which they strike is only 1-144th its former extent, and thus the impacting energy of the molecules is concentrated upon a much smaller space. They need less absolute heat to produce the same temperature effect as before, and their excess motive energy is yielded as sensible heat. In the case of expansion the surface upon which the molecules act is increased in extent, and their motive energy must be augmented to yield an equal effect. It is also possible that the results arising in these two cases may be aided by a variation in the effective vigour of intermolecular attraction, this increasing in compressed vapour, and decreasing in expanded vapour. This last mode of varying the degree of

latent heat, or increasing or decreasing the absolute heat contents of fixed quantities of matter by rarefaction or compression, has a very important cosmical significance, as we shall proceed to show.

The matter of space must, for two different reasons, possess a much greater absolute heat than the matter of the spheres. It is, in the first place, excessively more rare than the atmospheres of suns and planets. But, as we have just seen, gases become cooled by rarefaction, or, in other words, their absolute heat for equal temperatures increases. In the second place, the matter of space is in a more disintegrated condition than that of the spheres, and perhaps, to a considerable extent, completely disintegrated. But chemical disintegration also increases the latent heat contents of matter, or its absolute heat for equal temperatures. Thus the absolute heat of the matter of space must, for these two reasons, far exceed that of the matter of the spheres, if their temperatures be equal; or, if their absolute heats approach equality, the temperature of interspheral matter must be greatly reduced below that of the spheres.

Let us apply these conceptions to the case of the contraction of a nebula from its original diffused condition to the final state of a solar system. Our own solar system, in its nebulous state, was an excessively diffused gas, its material much more homogeneous and disintegrated than at present. If we assume that this nebula was of equal temperature throughout, then its heat contents must have approached equality. Equal temperature now between spheral and interspheral matter would indicate a wide difference in absolute heat contents, but in the matter of such a diffused and nearly homogeneous gas it would indicate but little difference. It is exceedingly improbable, therefore, that the matter of the primitive nebula was at a high temperature, or that it was a glowing gas, as so often assumed. Its high degree of latent or absolute heat could be only consistent with a low temperature, and very probably this temperature was considerably lower than the average of that of the earth's surface at present, for its condition must have more nearly approached the present condition of interspheral than that of spheral matter. It was, in effect, a vast sponge, filled with heat, which heat has ever since been pouring out, as gravitation has squeezed the sponge into smaller dimensions. The original heat of the sponge was in great part latent. Compression has rendered it in great part sensible.

Assuming, then, in the doctrine of the nebular hypothesis, that the primitive state of the solar system was that of a

diffused gas, with a considerable degree of homogeneity, with a temperature largely equalised, and therefore with a considerable accordance in its absolute heat contents, what effects would condensation produce on its heat relations? In considering the evolution of the solar system, scientists have attended principally to the physical aspects of the case, and but little to the force aspects. Physically we are presented with two marked results. One of these is a continued condensation of the principal mass of the matter of the nebula, and its aggregation into dense globes. The other is a continued rarefaction of the remainder of the nebulous matter, ending in the production of an excessively rare and highly disintegrated interspheral matter.

But such a process must have been accompanied by a great disturbance of the heat relations of this matter. As condensation continued, latent heat must have become sensible continuously, and the temperature of the contracting spheres must have greatly increased. And as rarefaction continued sensible heat must have become latent, and the temperature of the rarefying matter have considerably decreased. Also, condensation must have been accompanied by continual chemical integration, and rarefaction by chemical disintegration, thus considerably augmenting the above results. Thus the original partial homogeneity of temperature may have become a great heterogeneity, without any necessary disturbance of the original equality of absolute heat contents. The difference in temperature would be caused simply by the latent heat of the contracting substance becoming largely sensible, and the sensible heat of the rarefying substance becoming largely latent; the one being, therefore, in ordinary language, greatly heated; the other, greatly cooled. The final result has been, then, to replace the original partial equilibrium of temperature of the nebula by an extreme diversity of temperature between the matter of the spheres and of space, this great difference in temperature not, in itself, requiring any difference whatever in the absolute heat contents of these two conditions of matter.

Two necessary consequences arose from this evolution of a solar system. One was a steady increase in temperature of the central sun, which was not probably balanced by its heat radiations. This increase may still continue, and may continue for ages to come, for the radiations of the sun may not equal its increase in temperature through condensation. It is quite possible, then, that the sun, instead of cooling off, is yet growing steadily hotter, the sensible heat yielded by compression only slowly reaching its surface and outflowing

into space. The other consequence was a continuous effort to reproduce the lost equilibrium of temperature. This is a process which has continued for ages, and must do so for long future ages. The equilibrium which may have existed originally has been completely overthrown by the parallel condensation and rarefaction of matter. By the process of heat radiation Nature is seeking to produce a new equilibrium. This may eventually succeed, but can only do so by producing an excessive diversity in the heat contents of matter, since equilibrium of temperature between the dense matter of the spheres and the rare matter of space must signify a vast inequality of absolute heat.

(To be continued.)

IV. ANIMISM *versus* HYLOZOISM.

By J. H. BARKER, M.A.

"God is light."—ST. JOHN.
"He that built all things, is God."—ST. PAUL

ALTHOUGH I might fairly object to the *Dualism* of my critics, as exemplified in Dr. Lewins and his shadow C. N., yet as I love truth, whether in Religion or Philosophy, and as they court investigation, and are evidently actuated by the same spirit, I will reply candidly to C. N.'s article in the September number, without pledging myself to carry the discussion any further.

I believe I am doing no injustice to C. N.'s Hylozoism if I say that it regards Matter, consisting of an infinity of solid atoms, as the only Reality; that what we call Mind is nothing but a motion or function (a most vague and ambiguous term) of some of these atoms; and that they have existed from eternity. This is a revival of the old Atheistic doctrines of Democritus, Lucretius, &c.; and it will suffice to pit against them Seneca, Plutarch, Cicero, and especially those princes of heathen philosophy, Plato, Socrates, Xenophon, Hesiod, Epimenides, Xenophanes, &c.

This necessarily involves the conclusion that all mental processes, even the most complex,—all moral affections and emotions,—all imagination and poetry,—all knowledge, even the highest and noblest,—all the sublimest conceptions of the human mind,—are nothing more than the motions of solid atoms!! And this (I must call it) degrading view of human intellect is said to be Science, in the nineteenth century! But let us calmly examine this monstrous idea.*

If such are indeed the "inalienable" prerogatives of matter,—if it can, *of and by itself*, think, feel, choose, and calculate,—then it is what men in general call *mind;* and I hardly know whether the confusion of thought thus manifested, or the confusion of language, is most to be condemned. We have no data, no common ground for reasoning. We know not what we are talking about.

C. N. *assumes* that the Lucretian doctrine—of matter being composed of an infinity of solid atoms—is undisputed and indisputable. To say nothing of the visionary Idealism of Berkeley, derived from Oriental myths,—has C. N. never heard of the Physical hypothesis of Boscovich, as set forth in his "Theoria Philosophiæ Naturalis"? He maintains—upon the plausible ground that our bodily senses inform us of nothing more than phenomena, the actual causes of which are unseen Realities—that Matter has no objective existence at all; but that all the motions and properties usually ascribed to matter, can be logically accounted for, by assuming the existence of an infinitude of *centres*, from which emanate forces of various intensities, as well as of diverse kinds. By this view, therefore, Matter as an objective reality is wholly dispensed with; and the sceptic who denies the existence of mind as a distinct entity, finds himself confronted by "a scepticism still more sweeping, and reasoning still more refined than his own." Granted that both theories are inferences,—for they can be nothing higher,—still *mind* is demanded to form the inferences; so that the Materialist is fairly stranded; he can make no way, except by the recognition of the prior existence of Mind. It must not be supposed that I adopt Boscovich's theory. But I say, with confidence, that if the question is to be decided upon logical grounds alone, it is not Mind, but Matter, that is in danger of going to the wall.

Again, I ask, What is Reason, if it is not a faculty of

* On the general subject of spiritual realities I may refer C. N. (without saying that I accept all their conclusions) not only to Cudworth, but, in our own days, to the authors of "The Unseen Universe" and Fiske's "Cosmic Philosophy."

Mind? It cannot be a faculty of a solid atom, or molecule, or of a drop of water, or even of a living plant. Can these forms of matter reason, or draw inferences? Man, and perhaps also the higher classes of animals, *can* do this. And if so, surely no 'mens sana in corpore sano' can doubt the existence in these organisms of something which can deal with matter, and is therefore superior to it. The Materialist, then, who ventures to reason on the subject, first tacitly assumes that he *has*, or (more strictly) *is*, a '*mens sana*,' and then turns round and formally denies it. He cuts away the branch on which he sits, and the result is somewhat inconvenient.

The truth is, that C. N., and those who think with him, draw a wrong inference from an admitted truth, viz., that it is a law of our present economy, that one mind can only manifest itself or its working to another mind, by being embodied in matter. Moreover, it may possibly be a general law of all finite beings, that a material vehicle is a prerequisite to inter-communication of any kind. But this, if it be so, in no way proves that body and mind are not two distinct entities, blended rather than united, and mutually affecting each other.

Let me now point out another fallacious inference. Hylozoic Materialism, we are told (p. 521), maintains "the inherent vitality or energy of Matter." This appears to be borrowed from Strauss, who says "Life is only a special, viz., a most complicated, form of mechanics." Even could this be proved (which it cannot be), the whole tenour of C. N.'s articles show that he bases this theory on the allegation that Science has proved that every atom of matter is in constant motion, in one way or another.

Well, be it so. I do not deny it. But what then? This does not prove matter, *per se*, to be *alive*. Such a conclusion destroys all distinction between *life* and *motion*. Besides, this fact (if it be one) is at least as logically explained by the hypothesis of an ever-present acting Mind,—a personal though invisible Being, the all-wise Maker and Ruler of the world.

What conclusion can be more 'lame and impotent' than to say that a thing is *alive* because it moves? You must prove that it is *self*-moving, before you can prove that it is alive. Is a stone alive, because it moves when thrown by the hand of man? Does it choose its own course? or is it the human *will* that chooses it?

With respect to the (so-called) *axiom* of modern Science (p. 522), all that Science pretends to show is, that no portion of matter is in a state of *absolute rest*. It does not, and

cannot, deny that atoms may at times be *relatively* at rest.

C. N. having thought it desirable to repeat the argument respecting children and savages, I must revert to it in still plainer terms than those used in my last letter. Such reasoning, if it proves anything, shows that Materialism would bring us back to a state of mental barbarism and childishness, and limit our conceptions to that which is visible and tangible. It is virtually a retrograde movement, however 'advanced' its advocates may fancy themselves.

In p. 523 we have the following singular piece of reasoning:—"Except on the principle that the half is more than the whole, I do not see how a perfect being can be inferior to an imperfect one, and the very word 'immaterial' implies defect and limitation." Here *body* is called a perfect whole, and the *soul* an imperfect half. But the term "immaterial" implies no defect or imperfection; it simply means *not* material, and, as far as the word goes, may mean unlimited superiority to matter. If by "our physical structure" is meant our whole animated nature, I fully admit that it *is* capable of thought and sensation. But when the 'anima has quitted it, the body is a carcase, incapable of either.

In the same page we read, If *will* be destitute of dynamic power, it is a nonentity, an illusion." 'Will' *is* certainly a nonentity, for it is not mind, but the *working* of mind; and who ever calls *working* an entity? And who is there that is not conscious, ofttimes, of having the *will* to act, without the power to do so?

The motions referred to at top of p. 524 appear to me to show that the brain is not the only organ by which the mind acts, but that it is associated with the whole nervous system. Automatic motions imply, not the absence, but rather the presence of (unconscious) mind. All they show (in paralysis) is the suspension of the mind's control over the neuro-electric stimulus which affects the muscles. The actions of sleep-walkers decidedly prove the presence of mind, and of many of its faculties, though not that of consciousness.

We are further told (p. 524) that the *vis insita* of matter etymologically means an *indwelling*, but practically an *inalienable* force, which supplies the place of the Divine afflatus, and affords a logically sufficient 'cause.'" I grant that it may be the proximate, but not the independent and primary cause. It is itself an *effect*, as the word *insita* (as used by Newton) shows. For it does not signify *indwelling*, but *inserted* or *implanted* (the passive participle of the verb *insero*), and implies, what Newton always maintained, a Being who

implanted it. And this affords me an opportunity of illustrating what I mean by a *chain of causation*. The several actions stand thus:—The Deity—Will—Force—Motion. God exerts his Will, producing Force, which, when acting upon Matter, results in its Motion. I contend, therefore, that the Divine *afflatus* (by no means a happy phrase) is not superseded by this *vis insita*, but is equivalent to it.

The analogy suggested with relation to phlogiston and oxygen is fallacious. If phlogiston was supposed to be a "levitating factor," expelled by heat, while oxygen was a *gravitating* one, absorbed by the metal when calcined, it does not follow that such a substance as phlogiston *could* not have existed. If there were a form of matter lighter than air (*e.g.*, hydrogen), and it could have united with a metal without being condensed into a solid (as oxygen is in an oxide), while so united it would have made the metal lighter (in air) than when driven off from it. It is not so, in fact; but the possibility of it wholly vitiates the analogy here suggested, beside that no one supposes that the 'anima' is subject to gravitation. The subsequent assertion that certain *truths* have been corrupted into Dualism, is nothing better than a *notion*, and a very unfounded one too.

I beg to say, that I do not misapprehend the illustration taken from odours and poisons, but I deny its appositeness. *Why* combinations of the same elements in different proportions, when brought into contact with our nerves or senses, affect them so differently, it is impossible to say. I believe it to be an arbitrary appointment. But how totally different are the uncertain actions of a voluntary being from the definite effects of chemical compounds upon other matter!

In answer to the remarks in p. 525, upon animal life being the "outcome of certain chemical changes"—if the ambiguous word 'outcome' means 'initiation,' I ask, with confidence, What chemist has succeeded in producing a living organism except through the agency of previously existing life? The inferences from the late Mr. Crosse's electrical experiments were soon entirely abandoned.

Passing over the unseemly flippancy of the remark about a "ghostly Archæus," I fully admit the influence which alcohol, opium, &c., exert upon the mind through its material associate, the nervous tissue. But instead of this being a case of the "fiddle playing on the musician," it is one of a broken fiddle producing sounds quite different from a well-tuned one. The musician has (perhaps wilfully) damaged his fiddle.

With regard to the quotation from Dr. Lewins, I see little

difference between the "*anima mundi* and *anima humani*" being fundamentally the same, and "the question being the same."

C. N. seems to think that he has caught me on the horns of a dilemma, when he observes (p. 525) "An Infinite Mind 'giving existence to finite minds' must be limited by its own creations, and therefore be at once infinite and finite. Here again, I hold the premiss, but deny the conclusion. An Infinite Mind must be able to do anything which is not a self-contradiction. And if it sees fit to create finite minds, and *to give them the liberty* of even opposing itself, this is not parting with infinite power, but only voluntarily holding it in abeyance.

In p. 526 we read "If there be an *omnipresent* Deity, nothing else can have any real existence, and he must be the noumenon of which the Universe, subjective and objective, is the phenomenon." This is again a '*non sequitur*.' If God were matter, the admitted axiom that two portions of it could not occupy the same space, at the same time, would be applicable. But this would be a *petitio principii*. For what right has the Materialist to assume that no Reality exists but what is material? It is a naked assumption (contradicted by our own intuitive consciousness), which vitiates all his reasoning. And I maintain that it signifies *everything* whether we call the Supreme Reality a "God, Force, or Matter." I can hardly imagine a more convincing proof of the confusion of thought engendered by Hylozoism than such an absurd dictum.

I pass over the unintelligible sentence about Egoity and subjective Cosmos, to repeat my denial that the believer in an Omnipresent God is logically compelled to Monism—if by that term is meant the exclusive existence of one single entity, and that entity, Matter. Such an assertion may well be left to the common sense of ninety-nine out of every hundred readers. But I am no Pantheist. My Omnipresent God is a Being immanent in all things, though in a manner wholly inscrutable (not unknown or unthinkable) to our finite minds. He is as truly personal as our own minds are, though He immeasurably transcends them; and He has given our minds (or souls) the capacity of self-improvement and development, in order that we may, if we will, become more like Himself in goodness and in truth.

[In accordance with the wishes of many of our readers we must decline any continuation of this discussion.—Ed. J. S.]

V. THE SANITARY LEGISLATION OF THE PENTATEUCH.

STRANGE as it may sound, legislation concerning public health is not entirely a notion of this nineteenth century, sprung from the brain of the Southwood Smiths and the Chadwicks. Ages before the Society for the Diffusion of Useful Knowledge or the Sanitary Institute of Great Britain came into being we find regulations on sanitary subjects not merely proposed but formally enacted, invested with the most solemn sanctions of religion, and inseparably interwoven with the customs and polity of a remarkable people. These regulations, which have attracted surprisingly little notice considering that they are met with in a Book which has, more than any other, been closely scrutinised, both by its friends and its enemies, are, we think, not unworthy of attention from a scientific point of view. They agree most strikingly with the results of modern research, both in the recognition of danger and the precepts laid down for its removal or avoidance, and they are in too many respects far in advance of our actual practice. We propose to examine these laws, not from the position of the archæologist, the orientalist, or the divine, but simply from that of one interested in Sanitary Science. If we find that Moses has anticipated certain of our modern oracles we shall not seek to explain so suggestive—and to some persons unwelcome—a coincidence. The question whether or no some of the laws which we shall quote may not also have other and possibly even higher meanings we must leave to be discussed elsewhere. We think meantime that no one who has carefully traced the history of the human mind need feel surprised or offended at finding precepts on bodily health presented as under Divine sanction.

We will first call attention to the subject of blood. Nothing is more emphatically and repeatedly forbidden in the Books of Moses than its use as an article of food. What is the reason of this prohibition, which, as most people know, is very scrupulously obeyed by the Jews down to the present day? Theologians will perhaps pardon us if we submit that this has, in addition to other possible meanings, a physiological import which has in these days been too frequently lost sight of, even by many medical men.

The enactment is surely in complete harmony with the teachings of modern science. We know that the circulatory system has a double office: on the one hand it serves to convey fresh matter to supply the wear and tear of the system, whilst on the other hand it serves to carry off what may be popularly called the waste or refuse of the body. Such refuse is in due course eliminated by means of the kidneys, the sudiparous glands, &c., and appears then in its avowed character of excrementitious matter. It is therefore evident that the blood if drawn off promiscuously, arterial and venous together, contains a certain proportion of effete substances which are only fit to be expelled, and which are ill-suited for human food. If by any derangement the action of the kidneys is arrested, this refuse accumulates in the blood, and the consequences at once make themselves felt. Now as to separate the arterial from the venous blood of a slaughtered animal is impracticable, we contend that to use the blood as food approximates very closely to drinking urine, and is not merely loathsome but *pro tanto* unsafe. That, like liquid and solid excrements, it is valuable for plant-food, and that it serves as a pabulum for certain classes of animals, is no proof that it is fit for human consumption.

Even the mechanical state of blood when coagulated is a strong argument against its dietetic use. Unlike flesh, it is not composed of fibres between which the gastric juice can easily penetrate. It is a solid structureless mass like caoutchouc, which can only be acted upon from the outside of each fragment, thus rendering the process of digestion more difficult.

Turning from theory to practical experience, we refer to the higher value—in an actuary's sense of the word—of Jewish lives than of those of their Gentile neighbours inhabiting the same locality and engaged in avocations little different. Is not this recognised superiority on the part of the Jew due, in part at least, to their hereditary avoidance of blood during the course of three thousand years?

It is generally admitted that the internal organs of animals—such as the kidneys, the liver, &c.—are of questionable value as articles of food. They are, as we learn from carcase-butchers, very frequently in a diseased state, and are apt to be the seat of entozoa. We have not succeeded in ascertaining whether these parts are avoided by the Jews at the present day. But the law seems perfectly clear (Leviticus, iii., 15, *et passim*) that in all cases of beasts sacrificed the "inwards" must be destroyed by fire.

The disposal of blood did not escape the attention of the Israelitish law-giver. Directions are given that it is not to be let stagnate on the surface of the ground and there putrefy, but to be "covered with dust" (Leviticus, xvii., 13), or, in other words, absorbed in dry earth. Hence it seems fair to conclude that more than three thousand years ago the peculiarly offensive character of putrescent blood and the deodorising and disinfecting property of earth were known. Covering with earth is also the treatment specified for excrementitious matter. To the present day nothing is more offensively striking, wherever large numbers of human beings are collected away from their settled habitations, than the accumulation of filth which defiles the neighbourhood. Not merely sieges and other military operations, but engineering undertakings, fairs, camp meetings, pilgrimages, are characterised by nuisances of this nature, which doubtless assist in the propagation of typhoid fever, cholera, dysentery, &c., if the germs of these diseases are introduced. But Moses (Deut., xxiii., 12) gives special direction that excrement shall be dug into the earth. Indirectly this may be regarded as a prohibition against casting filth into the streams and watercourses. This view will appear strengthened by the decree that the falling of dead animals into small bodies of water (Levit. xi., 36) caused them to be regarded as unclean.

But whilst the use of blood as food is decidedly prohibited, and whilst its absorption in earth is enjoined, it figures in another capacity which has also a sanitary phase. It has been suggested to us that the application of blood to the doorways of the houses of the Israelites (Exodus, xii., 22 and 23) was not merely a symbolical act but a prophylactic measure. The destruction recorded as coming upon the Egyptians was probably some zymotic disease, the proximate cause of which would be morbific bacteria in the air. It is represented to us as not improbable that these bacteria, or other microbia, would be attracted and absorbed by the fresh blood sprinkled on the doorposts. This view of the case is fortified by the enactment that the Israelites were not to leave their houses in the morning. We are very far from presenting this supposition as demonstrated. But we understand that slaughtermen—who are, so to speak, constantly surrounded with *fresh* (in contradistinction to putrid) blood—are singularly free from epidemics. We have also witnessed experiments, which if not conclusive are at least suggestive. Organic solutions and infusions were placed in U-tubes through which air was drawn by means of a Sprengel pump. Before flowing into one of these tubes the air had to pass

over a number of fragments of pumice slightly soaked in blood, whilst in the other cases it was passed over pumice similarly soaked in gum-water, solution of sugar, and other adhesive liquids. In almost every case the organic solutions which had received their air over blood were much slower in showing signs of putrefaction than were the others. Our friend contends that fresh blood has a positive attraction for morbific germs independent of its glutinous character. Experimentation during some outbreak of pestilence is here wanting, and in the meantime we suspend judgment.

We next come to the distinction between clean and unclean beasts as affecting the choice of food. We find excluded all carnivorous animals (Leviticus, xi., 27), the rodents (*ibid.*, 5, 6, and 29), the carnivorous and carrion-eating birds (*ibid.*, 13 to 19), reptiles (*ibid.*, 30), amphibia, and mollusca (12). The question now arises whether these regulations are exclusively symbolical, or whether they have not at the same time a sanitary meaning. If we consider what animals are thus excluded we can scarcely avoid entertaining the latter view. We find on the prohibited list, in addition to the swine—that eminently unclean beast—the mouse, and, *a fortiori*, the rat, and, as included among the carnivora, the cat and the dog. Here, then, we have in a group those beasts which are the home of *Trichinæ*, and through whose means, directly or indirectly, these parasites are introduced into the human system. Is this a mere unintentional coincidence, or have we have not rather wise intention? It may be said that, save the swine, none of the animals thus mentioned are used for human food. Such an assertion would be a great mistake. Dogs are eaten in China, in Poland, and from time to time, much nearer home, in the form of sausages. Cats enter into the Portuguese, and we suspect the Italian, *cuisine*. Rats and mice are eaten, not merely by Chinese and Gipsies, but find their way occasionally into soups, stews, and the like in Europe. Indeed, in "this our highly favoured country," a certain person, probably influential and evidently ignorant, wrote to a daily paper recommending rats as food for the poor, and adding the humane suggestion that any man who complained of starvation whilst rats were plentiful should be punished! We will charitably hope that the writer was not aware that rats are foci of trichinæ, and are with good reason suspected of being one of the sources from which these pests find their way into cats, swine, and certain fishes, such as the pike. The domestic cat and all the feline group are frequently and seriously infested with internal parasites.

The prohibition of mollusca,—or, as they are familiarly called, shell-fish, and as we should interpret the passages in question, of crustaceans, such as the crab, lobster, and shrimp—may perhaps be considered needless. But not a few shell-fish, such as the common muscle and even the oyster, are at times capriciously unwholesome and even poisonous. The crustacea are not merely notoriously foul feeders—the shrimp being sometimes spoken of as the "scavenger of ocean"—but their flesh is decidedly hard to digest. The snail is specially prohibited by name. Certain species of this animal are eaten in modern Europe and rank as a delicacy. But as they devour herbs poisonous to man, and feed greedily upon carrion and upon human excrement, their use as food is something more than questionable. It has been contended in reply that an animal which nourishes itself on poisonous or loathsome matter is not necessarily on that account poisonous or loathsome. There is some force in this remark in the case of a large animal, where the stomach and intestinal canal, with their undigested or half-digested contents can easily be removed before the body is eaten. But in such small creatures as snails and shrimps such an operation could not be performed without a degree of anatomical skill and an outlay of time not to be expected from the ordinary run of cooks. Besides, it is too much to assume that an animal feeding on foul, morbid, and unwholesome matter may be in itself wholesome. The flavour and the odour of animal food, meat, milk, butter, &c., are most perceptibly affected by the diet of the beast from which they are obtained, and there is hence a strong probability that the flesh of a poison- or carrion-feeder will be more or less unwholesome.

The hare is included among the prohibited species. Unlike many of its fellow rodents, it is not carnivorous, but it eats many vegetable poisons, such as the bark of the mezereon. It would be very interesting to ascertain in what animals, after death, the volatile organic poisons now known as ptomaines are most readily developed? It is possible that in this respect a difference might be found in favour of the "clean" beasts and birds of the Mosaic law.

As far, therefore, as food is concerned, we see in some instances very sufficient physiological reasons for certain of the prohibitions, and we have grounds for suspecting at least that in other cases these regulations may be equally well-founded. Certain it is that the Jews by the avoidance of blood, of the flesh of unclean beasts, &c., have reached a standard of health higher than that of the Gentile nations

among whom they sojourn. Shall we therefore justly incur ridicule if we pronounce these enactments wise?

From food we proceed to the surrounding of human habitations. Not only in the East under its modern rulers, whether Islamite or Christian, not only in mediæval Europe, but down to a comparatively late date, the streets of cities and villages were the common receptacle of filth and refuse of all kinds, stray dogs being the only scavengers. Dead domestic animals, excrements, spoiled food, bones, the rinds of vegetables, and every other noisome and unseemly by-product of human existence and activity were allowed to accumulate in every corner. But why speak of streets? The interior of our houses, and even palaces and churches, three hundred years ago must have been perfectly loathsome to anyone—could such have been present—accustomed to cleanliness. How strange it is, then, to go back for more than three thousand years, and find in the laws of Moses directions that all unclean matter shall be cast into a waste place outside the city! The removal of nuisances was further made imperative by the command that if any person touched carrion or excrement he should be "unclean till the even." We can easily see that no Jew would be willing to tolerate any preventible nuisance in or near his dwelling.

We have, lastly, regulations on the subject of personal cleanliness. It is a sad fact that not merely mediæval but modern Europe constrasts most sadly in this respect with the principal nations of antiquity. One of the most striking features in the law of Moses is the number and variety of circumstances under which washing is required. Again and again we read—"He shall bathe his flesh in water." It may safely be said that in the ancient Israelitish community few persons would be able to pass a week without an entire washing. It may as safely be said that till very lately numbers of persons in modern Europe passed entire years without washing any part save the hands and a circuit of six inches radius from the tip of the nose. So peculiar is human progress that it has taken three thousand years to bring the civilised world to a point less advanced than that occupied by Moses. Less advanced we say emphatically, because if we now admit the value of personal cleanliness, the importance of avoiding putrescent and loathsome matters, and of expelling them rapidly from our cities, and if we are theoretically aware of the disinfecting and deodorising power of earth, we are far from embodying this our knowledge in the practice of actual life. As to the avoidance of blood, of the flesh of foul-feeding animals, and of such as are liable to

introduce Entozoa into our systems, we do not even recognise verbally the importance of the Mosaic teachings. We eat "blood puddings," we feed swine with blood and with semi-putrid offal, and then we eat the animals which have been gorged on this revolting diet. And we pay the price of this uncleanness in shortened lives and in waning vigour. We again call attention to the remarkable physiological insight displayed in the sanitary code of the ancient Israelites, and we repeat the question, Whence did it spring?

VI. THE DESTRUCTION OF NOISOME INSECTS.

By J. W. Slater.

In the September number of the "Journal of Science" (p. 437) I referred to the fly-fungus (*Empusa muscæ*) as a possible agent for the extirpation, or at least reduction, of insect intruders. Since those remarks I have had the opportunity of experimenting on the transfer of the fungus to other Dipterous species, and with but limited success. Having found three common flies which had perished of this affection in the usual manner, I carefully removed them from the window-panes on which they were fixed. On examination with a powerful lens their bodies appeared covered with a very luxuriant crop of the fungus. I placed them in a small vivarium, and turned in three blowflies, a *Stomoxys calcitrans*, and two common house-flies in a healthy condition. Some sugar was supplied as food for the colony, and placed in such a manner that the flies in visiting it might be liable to come in contact with the three dead specimens. All the prisoners came in frequent contact with the presumed source of infection. The blowflies especially walked over the dead, pushed them about, and touched them with the rostrum. In course of time the two live common flies became languid in their movements, took up their station upon the glass, and finally died in the usual manner, their bodies and the glass for some little distance being

covered with a well-characterised growth of *Empusa*. The *Stomoxys calcitrans* died about the same time, but with less distinctly marked symptoms. It did not become cemented to the glass, but was found on its back at the bottom of the compartment. Over its body there was a white fungoid growth, agreeing with that on the common flies, though much slighter. The blowflies, which had taken much more frequent liberties with the infectious specimens than any of their fellow-prisoners, showed not the slightest trace of the disease; they buzzed about vigorously whenever the sun shone, and died finally without any traces of *Empusa* upon their bodies.

I resolved upon a more decisive experiment. I found two more common flies which had just died of the disease, and catching two lively blowflies I applied the spores of the fungus to their bodies by means of a camel's-hair pencil, going over both the thorax and abdomen, and in particular the region about the spiracles. I then turned the blowflies into the same vivarium, and watched what might happen. To my surprise they manifested no symptom of the disease, and died after about a fortnight an apparently natural death.

Hence it appears that, at least under the circumstances of the above experiments, this disease is not communicable to the blowfly.

It may further be added that the infectiousness of *Empusa muscæ*, even among the common house-fly, is not very great. The specimens which we find dead of this affection never form any at all high percentage of the flies infesting our houses. If we consider how these insects are given to touch each other, as if in a sort of game, and how they crawl over those of their fellows who have fallen victims to the *Empusa*, we are led to wonder that the disease is not more widely spread. Whether it may be possible by any artificial cultivation to render this fungus more abundant and more easily transferred from one individual to another, it would be premature to decide.

I may here briefly notice some interesting results on the use of the *Pyrethrum* as an insecticide, an account of which in full is to be found in the "American Naturalist" for last month. The powder of this plant is not, as popularly imagined, a universal insecticide. It is indeed very doubtful if such a specific exists. But the *Pyrethrum* most unfortunately acts most intensely and certainly where its efficacy is least to be desired. All the Hymenoptera are said to succumb most readily. Now this order includes so very few

of man's enemies, and so many of his most valuable friends, that we might well pause before attempting any widespread application of *Pyrethrum* powder to our fields and gardens. Amongst the Hymenoptera are included not merely the honey-bee, but the various humble-bees, &c., which play so important a part in the fecundation of many flowers. Here, too, belong the ichneumon-wasps which so largely contribute to reduce the number of caterpillars. Hence any agent generally fatal to the Hymenoptera will require care and judgment in its application. If it is fatal to ants it may be of great value in checking the ravages of the leaf-cutting species, and of those which protect and even introduce Aphides and scale-insects.

On the other hand, we are told, as among the results of a course of experiments extending over three years, that *Pyrethrum* has no action upon the eggs of insects, or upon pupæ enclosed in hard cases. Many hairy caterpillars also remain unaffected.

Hence, though the plant can doubtless be grown to advantage in most sub-tropical countries, we must not expect too much from its application.

ANALYSES OF BOOKS.

Volcanoes: What they are and What they Teach. By JOHN W. JUDD, F.R.S., Professor of Geology in the Royal School of Mines. London: C. Kegan Paul and Co.

WE have here a work intended both to teach and to unteach. The author begins by showing the erroneous nature of ordinary school manuals as regards this subject. A volcano is not necessarily a mountain, but rather a hole in the earth's crust. When mountains do exist at the centres of such phenomena, they are formed by the matter expelled by the underground forces,—a mere consequence, and not a cause of what is in process. The action of a volcano bears no relation to burning; the supposed smoke is watery vapour, and the imaginary "flames" are merely the glow of melting rocks reflected from the clouds. The nature of volcanic action the author thinks may be best studied not in the violent outbreaks of such volcanoes as Vesuvius or Etna, but in the continuous and gentler action of Stromboli. Here it may be seen that the conditions on which the volcanic phenomena depend are the existence of apertures leading down from the surface to the interior of the earth, the existence of strongly heated matter below the surface, and the presence of quantities of pent up water underground, which is converted into steam and occasions the explosive outbursts which continually recur. Sulphuretted hydrogen and sulphurous acid are, indeed, emitted in quantities along with the steam, but the notion that the combustion of sulphur is the source of the heat is without foundation. Between the regular and mild action of Stromboli and the most dreadful outbreaks of Vesuvius the difference is simply one of degree, and a series of intermediate stages may be traced out. The lightning which accompanies the more violent eruptions is due to the friction produced by the escape of steam under high pressure from narrow orifies.

The action of volcanoes teaches us some highly interesting lessons concerning the earth's interior. We find that here there must be deposited matter of much higher specific gravity than that which forms the surface of the planet. The specific gravity of the entire globe is calculated by astronomical methods as being five and a half times as great as that of an equal bulk of water, whilst the materials of the earth's crust range only from two and a third to three times the weight of water. From this consideration alone we are forced to the conclusion that the deeper regions of the earth must be of much greater density. This conclusion is supported by an examination of the matter

thrown up by volcanic action. Hence it becomes highly probable that the interior of the earth consists chiefly of metals in a free state. If this view is correct it points to a process by which our globe will be in the course of ages rendered incapable of maintaining life, as the oxygen of the air will be gradually absorbed by these vast masses of metal.

As regards the physical condition of the earth's interior, the author does not accept the hypothesis, once in great favour, that it consists of a mass of molten matter enclosed in a thin solid shell. Independent of the astronomical and physical arguments for the earth's rigidity, amongst others that founded upon the absence of subterranean tides, he contends that if volcanic products were supplied from one common reservoir in the interior of the earth, the lavas should exhibit a much greater similarity of composition than is actually the case. But he admits that none of the hypotheses concerning the earth's interior is free from objections, and that we are not yet able to come to a final decision.

As regards the internal heat of the globe and the causes of volcanic action, we have also much to learn. Prof. Judd admits the rise of temperature as we bore deeper into the globe, and he even suggests that at no distant time "we shall draw extensively upon these supplies of subterranean heat." But the increment of temperature is not uniform; it varies in different parts as 1 : 5, and in not a few borings it has been found that the rate of increase after a time becomes slower. Thus in the well of Sperenberg, near Berlin, the rate of increase is 1° F. for every 55 feet, during the first 1900 feet of descent, but for the next 2000 feet it diminished to 1° F. for every 62 feet. A similar fact was observed at the well of Grenelle, at Paris. These phenomena do not agree with the assumption that in descending we are approaching a great focus of heat.

On the other hand, in the Comstock Mine the rise of temperature becomes accelerated at depths below 2000 feet.

In abruptly concluding oure notice of this interesting work we may fairly pronounce it a most able and judicious production. The author carefully eschews rash theories, and knows how to suspend judgment where the necessary evidence is not forthcoming.

Proceedings of the Literary and Philosophical Society of Liverpool During the 69th Session, 1879-80. No. XXXIV. London: Longmans and Co. Liverpool: D. Marples and Co., Limited.

Of the papers selected by the Council a very considerable proportion fall outside our cognisance entirely. We may mention "The Place and Power of Criticism," by the President, Mr. E.

R. Russell, who, in a former paper ("Journal of Science," 1879, p. 372), took occasion to sneer at Science as "blind and groping physicism." We need, therefore, feel little surprise at finding him come forward as a champion of competitive examination, and pronouncing the "popular cry against cramming not very respectable."

Two of the papers, viz., that on "Money, Coin, and Currency," by J. A. Picton, and "Plan of a Self-Acting Method of Regulating the Stock of Gold for the Paper Currency," seem to us more suited for a chamber of commerce.

Concerning "Eirik the Red's Saga" and the "Life of Mr. Justice Story," we have nothing to say, and may make a very similar admission concerning a memoir entitled "On the Simplest Possible Experiment in Physical Science," especially as its author, the Rev. T. P. Kirkman, F.R.S., has at the conclusion criticised himself.

Mr. A. J. Mott, F.G.S., examines the "Nebular Theory," and points out some very grave objections to its truth. He suggests that "the heat radiated into space cannot be really lost, but must be retained as energy in some other form, possibly in the form of the cause of gravitation, to make the duration of a moving and living universe practically without limit, both in the future and in the past."

"Life in the Lowest Organisms" is the title of an interesting paper by the Rev. H. H. Higgins. The author remarks very justly that "no one has ever seen or known protoplasm, except as *the* protoplasm of some special form of living animal or plant." Speaking of *Protomyxa aurantiaca*, which Prof. Hæckel pronounces the lowest known living animal, he shows that it is capable of feeling hunger, and asks how is this sensation to be accounted for? "Here, where we cannot go back to preceding lines of evolution, where there is no hereditary chain that we know of, at the very base of the scale of life, hunger is exhibited." "No alternative seems to be left but to describe this habit of the creature (its encasing itself with grains of sand, &c.) as representing the first beginnings of that selective instinct by which . . . . untutored man himself sets up his hut or his wigwam." Mr. Higgins points out the beauty of the shell of the *Polycistina* as inexplicable on the mere principle of utility. Neither, he holds, was it developed only for man to admire. He shows that twelve of the most prominent characteristics of the world of life appear in the lowest form of living things, whilst lifeless matter is destitute of any of them. "In the present state of our knowledge the beginning of life must, it would seem, be held to be an exception to *ascertained* continuity in Nature as expressed by the theory of evolution." The author, if we remember rightly, has on former occasions used the term Evolution, not as including, but as in some respects opposed to, Darwinism. He remarks that "constitutional differences between specimens of the same

species in the lower classes of organisms form an almost unexplored field in Biology." The following reflection is suggestive:—"An imperfect adjustment between qualities good and indispensable in themselves may be the source of all the mischief commonly attributed to propensities radically evil." In this brief essay there is more of original, valuable thought than we often meet with in bulky volumes, and we earnestly commend it to the study of all biologists.

The preliminary report on specimens dredged up from the Gulf of Manaar, by H. J. Carter, F.R.S., points to important results in the future, both biological and geological. The author thinks that this little inlet contains an epitome of nearly all the marine organisms existing in the Indian Ocean. He thinks that as yet we have hardly entered upon the dawn of all the sponge life that exists on the surface of the globe.

The last memoir in the volume, and with one exception incomparably the most valuable, is by Rev. W. H. Dallinger, F.R.S., and is entitled "Life-Histories and their Lessons: A Defence of the Uniformity and Stability of Vital Processes as Controlled by the Laws of Evolution." In it he discusses and controverts the hypothesis of heterogenesis, which he shows to be by no means essential to the doctrine of Evolution.

Mr. C. D. Jones, C.E., of San Paolo, Brazil, communicates additional interesting matter on Lepidoptera of that region.

The examination of this volume has confirmed us in a notion which we have long entertained, that our "Literary and Philosophical Societies" ought to be submitted to a process of dissociation. Each of their elements would be better in a "free" state.

Journal and Proceedings of the Royal Society of New South Wales, 1880. Vol. XIV. Edited by A. LIVERSIDGE, Professor of Chemistry and Mineralogy in the University of Sydney. Sydney: Richards. London: Trübner and Co.

WE cannot profess to be wholly satisfied either with the present volume or with the condition of the Royal Society of New South Wales. We learn with regret that the Biological Section, along with several others, has not met during the year 1880. Among the papers read before the Society, Biology is merely represented y a "Catalogue of Plants Collected in North Western Australia." This circumstance is the more mortifying when we reflect how very much remains to be done in the zoology of Australia itself, and of the islands situate to the north east.

Nevertheless, there is much matter in this volume which must claim the careful attention of men of science.

We turn first to the "Anniversary Address," delivered by the Vice-President, Mr. C. Moore, F.L.S. The speaker referred to the dying off of various species of Eucalyptus in the Camden district. This affection occurs in belts, usually running north and south, the trees on either side remaining unaffected.

Mr. Moore next referred to the very curious contention raised by a Mr. W. E. Abbott, of Glengarry, that the destruction of forests does not affect the rain-fall, or cause the drying-up of rivers by increased evaporation! An assumption so flatly opposed not to "theories," but to positive observations made in almost every quarter of the globe, ought, we think, to have been advanced with much more reserve. If some unseen fallacy does not lurk in Mr. Abbott's statements, it will follow that Australia differs from the rest of the globe in its climatic conditions no less than in its fauna. It will be, we think, highly unwise if the Colonial governments allow the destruction of the forests to proceed—whether by "ring-barking" or any other method—without very much more evidence than has yet been produced.

Another remarkable feature in the Anniversary Address relates to insectivorous plants. Mr. Moore tells us he is "in the unhappy position of being unable to acquiesce in the doctrine that the plants termed insectivorous, or those that are said to derive their nourishment (? a part of their nourishment) from animal matter, were intended by nature to depend on or benefit by any such means for their support." He admits, of course, that certain plants catch insects, but denies the purposiveness of such capture.

Baron Mueller's catalogue of the plants of North-western Australia brings some interesting facts to light. Out of the 400 species collected by Mr. A. Forrest and Mr. J. Forrest during their surveying expeditions, there is not a single orchid. Mr. R. D. Fitz-Gerald has produced a valuable monograph, beautifully illustrated, of the Australian orchids. Mr. Bailey, F.L.S., of Brisbane, is working up the lower orders of the Australian flora.

A paper read before the Medical Section, by Dr. F. Norton Manning, is of grave importance. It is a very serious consideration that even in so young a community as Australia, free, as it might be thought, from many of the evils which affect overcrowded countries, the spread of insanity should excite the attention of far-seeing men, both within and without the profession. Intemperance, Dr. Manning shows from his experience at the Gladesville Asylum, is responsible for about 8 per cent of the cases. He agrees with Dr. Grabham, Dr. Bucknill, and other English physicians, in maintaining that the effects of drunkenness, in this direction, have been grossly exaggerated. He points out that even kerosene is used in the adulteration of alcoholic drinks. As remedial measures, he suggests a reduction in the number of taverns, the introduction of sound light wines—which in Australia might certainly become the common drink of all

classes—and the general use of ice. In this last point we cannot agree with him; the habitual use of ice and iced water in America, in the hot weather, is recognised as a fruitful cause of congestion of the brain.

In connection with sun-stroke the author mentions that 5 per cent of the cases of insanity in Australia are due to this affection. He states that a thermometer graduated up to 234° F., and exposed to the sun with its bulb wrapped in black cotton-wool has been known to burst. Hence he justly denounces the "black stove-pipe hat," to which Englishmen and their colonial descendants cling with a pitiable fanaticism.

He fully admits the hereditary transmission and multiplication of insanity, and hopes that in a more enlightened future when the whims of the individual are subordinated to the good of the community "it will be found expedient in the interest of future generations to insist on prolonged isolation or operative interference in the case of all persons who have been afflicted with mental disease." Joining Dr. Manning in the wish, we cannot help fearing that we are drifting in the very opposite direction.

On the influence of consanguineous marriages in occasioning degeneracy, and in particular insanity, the author speaks with some reserve. He remarks, however: "In the few cases in which two imbecile children in one family have come under my observation, the parents have always been nearly related, and in the only instance in which I have known three children in one family idiotic, I obtained evidence that they were the offspring of the incestuous union of brother and sister." He also quotes Dr. Mitchell, one of the Commissioners of Lunacy for Scotland, who ascribes 10 per cent of the idiocy of Scotland to consanguineous marriages.

The author's opinions on the worry, haste, and competition of modern civilisation as factors in racial decay, and especially in the spread of insanity, we most cordially endorse. He denounces "our present system of stuffing our youth and making all boyhood and girlhood one long period of cramming for examinations. . . . . The whole system tends to confuse and distract the mind, to unfit it for the work of the world, to stunt originality, and to induce what has not inaptly been termed 'brain-fog.' Where there is no breakdown at the time—and instances of this are much more frequent than is commonly supposed—seeds are planted for the growth of mental disorder later in life. I know no stronger evidence as to the evil done by overwork in schools and competitive examinations than that of Dr. Andrew Clarke, who states that he has discovered temporary albuminuria in 10 per cent of the candidates sent him for examination as to physical health after passing the Civil Service examination for India."

Who that has sufficient medical knowledge to comprehend this one fact will not execrate the "Playfair scheme?"

Annals of Chemical Medicine, including the Application of Chemistry to Physiology, Pathology, Therapeutics, Pharmacy, Toxicology, and Hygiène. Vol. II. Edited by J. L. W. Thudichum, M.D. London : Longmans and Co.

HERE, as in the former volume of the work, we find an assortment of memoirs, which, in their thoroughness, and freedom from unwarranted assumptions, are deserving of recognition and imitation.

One of the most interesting of these papers is entitled "Anæsthesia by Volatile Alkaloids, as illustrated by Opium Smoking." Here, the author not merely shows the value of this much-denounced practice in pulmonary consumption, especially when attended with diarrhœa and blood-spitting, in bronchitis, neuralgia, pneumonia, carbuncle, &c., but exposes the sensational statements indulged in by the "Friend of China." It is certainly strange, if, as is sometimes said, we "force" opium upon the Chinese, a large and increasing quantity of this drug—not less than five million lbs. yearly—is grown in China itself!

A paper on "The Fate of Morphia in the Body" is also important. Even if injected into the subcutaneous tissues it is soon decomposed after it finds its way into the blood. This fact is the more significant because the attempt was made, not very many years ago, to define poisons as bodies which, if introduced into the system, remained in it for a time unchanged, and were finally, if not taken in fatal doses, eliminated as such. Now, as morphia is an admitted poison, the definition which, we believe, was originally proposed by the "physiologists of temperance," falls to the ground.

In a memoir on the "Sources of Urea in the Body," Dr. Thudichum considers that there are many and weighty physiological objections to the hypothesis that all albuminous matters in the course of biolysis in the body are split up in the same manner as by chemolytic means out of the body.

The paper "On the Decrease of Hæmochrome in the Blood in Diseases and under Insalubrious Influences" is a valuable summary.

A memoir on the "Phosphorescence of Organic and Organised Bodies" contains many facts which must be borne in mind by those who are inquiring further into the distribution and the significance of this phenomenon in the organic world. It would appear that the phosphorescence of living beings is attended with an increased consumption of carbon, and therefore, of necessity, with increased heat. Fabre observed that the fungus *Agaricus olearius* gives off much more carbonic acid when phosphorescent than when dark. Almost all observers agree that both for plants and animals the presence of oxygen is necessary for the manifestation of phosphorescence. Panceri, Secchi, and

Phipson maintained the mono-chromatic character of the light of marine animals, but Secchi, on repeating his observations with more perfect instruments, found that the light of *Lampyris* and *Pyrosoma* yielded a continuous spectrum, the red and violet parts being, however, very feeble. It is here stated that the phosphorescence does not seem to be under the control of the will of the animal. Certain observations made upon insects do not agree with this view, as they appear able to emit their light at short rhythmical intervals, or to suppress it altogether if alarmed. The subject is by no means thoroughly understood.

The Popular Science Monthly. September, 1881.

In this ably-conducted journal there are some articles demanding especial notice.

Dr. F. L. Oswald continues his valuable papers on Physical Education. He tells us, however, somewhat strangely that "the young of other creatures (than man) are healthier than the adults." We strongly doubt the accuracy of this statement. Many species, both animal and vegetable, are difficult to rear, though healthy and vigorous enough when once the stage of infancy is past. He denounces "Sauerkraut," and has evidently no sympathy with cod-liver oil.

An article on the "Increase and Movement of the Coloured (more correctly Negro and Negroid) Population," by J. Stahl Patterson, presents certain conclusions of grave import to the whole civilised world. According to the results of the last census the negro population of the States is increasing more rapidly than the Aryan part of the community in the ratio of 34·8 to 29·2. This result shows that the assumed tendency of the lower races to die out in presence of the superior does not hold good. The writer shows that if the rates of increase registered during the last decade are continued, in another century the United States will be not an Anglo-Saxon, but mainly a negro republic. *Absit omen!* Incidentally he contends that the possession of high culture is a surer check on population than the "positive checks" of Malthus. This is, indeed, the fatal flaw of Malthusianism. Unless it could be forced upon the lower races, and upon the criminal, debilitated and idiotic portions of the higher, it must lead to the ultimate suppression of the *élite* of mankind.

In an article on the "Progress of Higher Science Teaching," by W. H. Stone, borrowed from the "Popular Science Review," the writer seems to overlook the fact that the old system of education erred by fixing the attention of the pupil upon words instead of things, and thus failing to train him up in the art of observation. Now, Science, if righly taught, makes the pupil an observer.

Proceedings of the Literary and Philosophical Society of Liverpool during the Sixty-eighth Session, 1878-79. No. XXXIII. London: Longmans and Co. Liverpool: D. Marples and Co. (Limited).

This volume contains some very valuable matter. Dr. J. J. Drysdale contributes a very elaborate memoir on the "Germ Theories of Infectious Diseases." He warns us that we have no warrant for supposing that the days of epidemics are over. "The immunity of any generation from the greater plagues may be merely an interruption of the course liable to terminate any year by a fresh outbreak of some old or a quite new plague." Following Liebermeister, he divides the diseases in question into three classes:—the truly contagious, where the *materies morbi* is reproduced in the organism suffering from disease, such as small-pox, plague, typhus, &c.; the miasmatic, such as the remittent and intermittent marsh-fevers, where the poison is developed externally to the body; and lastly, the miasmatic contagious diseases, such as cholera, dysentery, and typhoid, where the secretions of the infected persons undergo a further development out of the body. On the exact nature of infectious matter it may be at any rate regarded as ascertained that the specific power does not reside in anything gaseous, liquid, soluble, or diffusible, but in particulate matter. Such matter will either be an organised ferment, a parasite, or a portion of living matter capable of transplantation and growth in the bodies of other persons. The inference, however, that the growth and development of parasitic microphytes in the blood is the cause of specific diseases in general, Dr. Drysdale considers as somewhat hasty. He maintains that "one of the chief aims of medicine should now be to turn these fearful engines of power (infectious diseases) into agents of protection against and cure of the very evils produced by their uncontrolled natural operation." The memoir is deserving of very careful perusal, and of a much more thorough investigation than space allows us to give.

The Rev. H. H. Higgins undertakes to give an answer in the negative to the question "Is Nature cruel?" By cruelty he understands that which is exhibited in the infliction of needless and profitless pain." In examining the argument it may be sufficient to turn to the learned author's defence of the mosquito as a sanitary agent. Admitting for argument's sake,—and it is an enormous admission,—that the tundras of Siberia and the plains of the far north-west of America would suffer from malarial fever were it not for the operations of the larvæ of mosquitoes, overlooking the fact—referred to by Dr. Drysdale in the memoir just referred to—that these insects are the conveyers of disease from person to person, we point to the circumstance hat millions upon millions of them live and die without ever

tasting human or indeed any kind of mammalian blood. Hence it follows that such blood is not necessary to their existence, and that the pain which they inflict is as "needless" as "profitless."

Mr. A. E. Nevins is the author of a paper on "Modern Meteorology, considered in its Bearing upon Tropical Storms." He argues that in whatever part of a storm a ship is, she will be approaching the centre, in a more or less oblique direction, if she runs dead before the wind. He raises the question whether the two currents of air forming such storms are not charged with electricity of opposite names?

J. Linton Palmer furnishes some interesting notes on the "Colours of the Sea."

The Rev. T. P. Kirkman, F.R.S., writes on the "Solution of the Problem of the Autopolar *P* Edra with Full Construction up to $P=10$." He remarks, "It may come to be evident, although I confess that I cannot clearly conceive how, that this complete theory of the polyedra is a necessary introduction to dynamical science yet undiscovered." He adds, "For look how grandly we can talk about matter and law—this Realm of Matter and this Reign of Law! or, more accurately, this Realm of Rubbish and this Majesty of Must-be."

Richmond Leigh, M.R.C.S., treats very ably on "Changes of Climate, Secular and caused by Human Agency." He expounds in particular the dire mischief which has been occasioned by the wanton aud reckless destruction of forests.

Dr. Francis Imlach contributes a memoir on the "Levantine Plague, Past and Present," and warns us to be wise in time.

Mr. F. P. Marrat, in a paper on the "Arrangement of the Shells in the Genus *Nassa*," remarks that fully nine-tenths of the shells now ranking as species will be found to come under this general term (*viz.*, intermediate forms, and even many of those at present appearing as distinct will find a place in this series.

Mr. E. D. Jones, of San Paolo, Brazil, communicates some very valuable notes on the larvæ and pupæ of Brazilian Lepidoptera. The larva of a *Papilio* (species not named) is described as having the power of flinging a drop of a fluid (colourless, but possessing a very pungent and offensive odour) upon the offending object. The author is doing exceedingly useful work in studying and recording the metamorphoses of the Brazilian butterflies.

At one of the meetings of the Society Mr. Jos. Boult argued that overcrowding is by no means so important an element in the causes of a high death-rate as is generally supposed.

Spon's Encyclopædia of the Industrial Arts, Manufactures, and Commercial Products. Division IV. Edited by C. G. WARNFORD LOCK. London and New York: E. and F. N. Spon.

THIS part of Messrs. Spon's work shows no falling off in the value of its contents. In the article on Ivory we note some interesting facts on the growth of the tusks, not only in the two species of elephant, the Indian and African, but in different breeds in each country. Thus the tusks from Bengal rarely exceed 72 lbs., and those of Tipperah 50 lbs., whilst tusks from Pegu and Cochin reach a weight of 150 lbs. Turning to the African species, we find Zanzibar tusks averaging 122 lbs., and at times ranging up to 227 to 280 lbs. Tusks from Angola, on the other hand, do not average more than 69 lbs. Hence the size of the tusks cannot be accepted as a decisive point in the diagnosis of species.

The article on "Mordants" compresses into brief space a wonderful amount of practical information, and is evidently the work of some writer thoroughly acquainted with his subject, and not of one who has "read up" for the occasion.

The chapter on "Narcotics" is exceedingly instructive. The following passage on opium will perhaps surprise some of our philanthropists:—"With regard to its use as a narcotic great efforts have been made by a few well-intentioned, but ignorant, people to procure its annihilation. But though the abuse of the drug leads to evil consequences,—by no means equalling, however, those of the abuse of alcohol in this country,—its moderate use is extremely beneficial, if not absolutely necessary, in the malarial climate of China; and the immunity of opium-smokers from diseases of the bronchial tubes and lungs, so common among non-smokers, is remarkable." The production of opium in China itself is increasing, despite paper-prohibitions, and already supplies 5,000,000 lbs. out of a total yearly consumption of 17,000,000. Persia likewise exports to China an increasing supply of opium which successfully competes with the Indian growth. Hence it appears highly probable that if our philanthropists would abstain from the luxury of agitation, they might see the Indian opium-trade gradually dwindle away.

It is a remarkable fact that the strongest samples of opium have been produced in France, where percentages of 20 to nearly 23 per cent of morphia have been reached. The maximum proportion in Smyrna opium is 21·46 per cent, whilst the highest point reached in India (Patna) has been 8·6 per cent. It is worthy of note that in countries where legislative attempts have been made to abolish the consumption of alcoholic liquids, the use of opium and its preparations is decidedly on the increase.

It is strange and not pleasant to learn that 230 poods of the

poisonous Siberian toadstool (*Amanita muscaria*) have been imported into England in one year. Such a quantity can scarcely have been consumed in medicine or in chemical research, and we therefore fear that it is employed among us as an intoxicant.

The article on "Nuts" will be found very suggestive by all who are interested—and what far-seeing man is not?—in the growth of our colonial resources. It is stated that in India the coco-nut trees are often damaged by a Curculio (*Calandra Berquetii* or *palmarum?*) which the writer terms an "elephant-beetle"—a misleading name. This pest "reappears at intervals of two, three, or more years." These periods ought to be more closely observed.

The chapter on "Oils," including as it does the saponifiable, the essential, and the mineral oils, is the most extensive and elaborate in the whole volume. We have often been struck with the feasibility of introducing palm oil into this country in such a state as to supersede "butterine" and its kindred mixtures. All that is necessary, we believe, is to add to the oil a trace of salicylic acid to prevent rancidity. Non-rancid palm oil is exceedingly pleasant in flavour, and would possess the advantage of entire freedom from the ova of Entozoa, and other abominations which have often been traced in butterine.

We are thoroughly satisfied of the value of "Spon's Encyclopædia" for merchants, manufacturers, &c., who will here be able to lay their fingers upon information which they might otherwise seek for in vain.

Monthly Notices of Papers, and Proceedings and Report of the Royal Society of Tasmania for 1879.

The Tasmanian Society has been doing no small amount of useful work.

A. B. Crowther, M.R.C.S., communicates a paper on some points of interest connected with the Platypus. Every point in the reproduction of this animal, except the actual birth of the young, has now been elucidated, and the supposition of its oviparous character is now completely abandoned. A curious feature is that the mammary glands of the female appear and disappear with great rapidity. Two or three months before the birth of the young not even a rudiment of the gland can be discovered, and it as completely disappears when no longer needed. The poisonous character of the secretion ejected through the hollow spurs on the right legs of the males is fully proved. It is employed by them when fighting for the possession of the female. About the breeding-season specimens are often caught with

patches of ulceration on their skins resulting from poisoned wounds.

Baron F. Von Mueller supplies a "Census of the Plants of Tasmania," up to 1879.

Mr. Justice Dobson and A. Simson both contribute papers on the codlin moth (*Carpocapsa pomonella*), a depredator which is committing serious mischief in the apple and plum orchards of the colony.

R. M. Johnston gives a memoir on the "Natural History of the Marine Tertiaries of Table Cape," with a description of thirty new species of Mollusca; and notes on the "Distribution and Variability of Tasmanian Land Shells."

The Right Rev. Bishop Bromby, D.D., read a paper on the "Law of Storms," with especial reference to the Southern Hemisphere. He considers that in the Tasmanian waters a storm generally arises from a conflict between an easterly and a westerly wind, the easterly always flowing on the polar side of the westerly.

We are happy to find that there are in Tasmania persevering and able observers who turn their attention to local phenomena,

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The Microscope and its Revelations. By W. B. CARPENTER, C.B., M.D., LL.D., F.R.S., &c. Sixth Edition. Pp. 882, 26 Plates, 500 Wood Engravings. London: J. and A. Churchill. 1881.

IT is pleasing to see another edition of this well-known handbook. Our veteran microscopist has undertaken the work with his old vigour undiminished; keen both in sight and intellect. No new discovery has escaped him, and the book faithfully represents the state of microscopical science up to the time of going to press.

The title naturally suggests the plan of the work; this, indeed, has been but little changed through the whole of the six editions, save in the alteration caused by scientific progress, and the extension of some important subjects. To the instrument itself four chapters are devoted, the first containing a plain account of the optical principles of the microscope, the remaining ones containing a description of the various kinds of microscopes made both in England and abroad, and the various accessory apparatus employed. The mode of using the microscope is described at great length. The notes on errors of interpretation are very important, and include the new discoveries of Professor Abbe on diffraction spectra. The value of these cannot be overrated, and Dr. Carpenter has done well to give great prominence to the

subject, for, although already published, it is still unknown to many microscopists, and little heeded by many more.

The chapter on mounting and preparing objects includes all the most recent processes in the time that has elapsed between the publication of the present and the former edition. The improved processes of section cuttings, aided by the use of reagents for staining, hardening, corroding, and in other ways rendering obscure structures more readily visible, have quite revolutionised this department of microscopical science. The student will find here an account of nearly all the best processes in use, and references to many others not included in the book. This chapter concludes with some valuable hints on collecting. The author's experience in the "Porcupine" and "Challenger" expeditions renders him a reliable guide on all matter relative to marine collecting.

The remaining two-thirds of the work is occupied, as of old, with an account of the minute structure of the vegetable and animal kingdoms. In some departments—for instance, the Foraminifera—Dr. Carpenter is probably the greatest living authority. The result of his researches on *Eozoon* are given at some length. The descriptions throughout are interspersed with the mode of carrying on the needful observations where necessary to supplement the instructions given in the earlier portion of the book. These notes in special modes of observations are of great value, as microscopists, in describing the results of their observation, too often take it for granted that the means by which these results are attained are known to everyone, while, as is often the case, special apparatus or treatment has been necessary to ascertain some most important fact.

On the vexed question of aperture of object-glasses Dr. Carpenter expresses a very decided opinion. While admitting the value of well-corrected objectives of the large apertures recently attained, for a certain set of purposes, he cannot endorse the statement of some enthusiasts, that with such excessive apertures alone can structure be truly made out. Evidence is certainly in Dr. Carpenter's favour; for some of the most important discoveries of modern times have been made with objectives of high power and comparatively small aperture, and the value of an amount of great depth, not to be had in combination with very great aperture, has often to be considered.

It is to be regretted that, in this and one or two preceding editions, space could not be found for the introductory chapter which formed so interesting a commencement to some of the earlier editions.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HAILSTORMS.

To the Editor of the Journal of Science.

SIR,—I am preparing a memoir for the Meteorological Society, on "Hailstorms." Might I ask you to assist me by requesting any of your readers who have opportunities of observing hailstorms to furnish me with particulars of them? The points to be particularly observed are as follow:—

1. *Date*, and hour of the day.
2. *Area of the Storm*. If it assume the tornado form, give (*a*) length of the course, (*b*) breadth, (*c*) direction of motion, (*d*) rate of progression.
3. *Physical Features* of the locality: (*a*) elevation, (*b*) mountains and plateaux, (*c*) rivers and valleys, (*d*) forests, &c.
4. *Temperature:* (*a*) before the storm, (*b*) after the storm, and, if possible to be observed, (*c*) changes during the storm.
5. *Barometrical Readings*, frequently taken during time of hailstorm.
6. *Wind:* (*a*) direction near the earth's surface, (*b*) direction in the higher regions as indicated by the cloud-motions, (*c*) force.
7. *Preceded or followed by Rain.*
8. *Aspect of the Clouds*. Note if there is any appearance of two separate strata at different elevations.
9. *Electrical Phenomena*. Should there be lightning, note the relation between the discharges and the fall of the hail—whether the lightning precede the hail, or *vice versâ*.
10. *Duration* of the storm at one spot.
11. *Sound*. Note if a peculiar noise precede the descent of the hail.

12. *Conformation and Size of the Hailstones.*
13. General character of the weather before and after the storm.

I should also be glad to receive references to previous memoirs on hail, or accounts of storms.

You will much oblige by giving publicity to this.—I am, &c.,

F. A. B. Oliver.

Athenæum, Glasgow, July 26, 1881.

AËRIAL NAVIGATION.

To the Editor of The Journal of Science.

Sir,—I venture to trespass still further on your forbearance, in continuation of my letter on "Aërial Navigation," in your issue for August.

I cannot deny that I fear there may be such horrors as you hint at, as the concomitants of the immediate *beneficial* results of the practical solution of this problem. So long as men's minds are blind to the full blessings of progress, the "ape and tiger" lurking in most of us will come into view on suitable opportunities. Let us hope, however, that the development of communications will ever tend to exercise its educating and humanising power over "the ruder, less civilised portions of the globe;" though whether the more civilised and more enlightened nations will awake to the conviction of the *worse than waste* of war, without a rude shock, it is vain to foretell.

But must the car of progress be stopped because some infatuated spectators may make it a car of Jaganát to their fellows and themselves, and because the world may abuse the mental, moral, and material gifts it brings? Must (*e.g.*) chemistry cease to add to the wealth and comfort of man, because desperate or dastardly individuals use some of its discoveries to further their own unprincipled ends?

The war fiend appropriates to its own devilish ends the triumphs of Steam and Electricity. Must these be therefore discredited, and because their power for good may be largely discounted by their power for evil? Must, then, progress be delayed until man is fit to receive its fruits; or should we (like Victor Hugo) "believe in all kinds of progress," and endeavour to educate man to refrain from abusing his new wealth? Should we not hope that thus, and that soon, "the common sense of

most" will be able to hold such "fretful realm in awe," and that "the kindly earth shall slumber, lapt in universal law"?

* * * *

"Science moves but slowly, slowly,
Creeping on from point to point."

Should we then endeavour to make it move *more* slowly because we dread the power it may give to the unscrupulous? I think not.—I am, &c.,

AERONON.

THE SMELL OF THE INSANE.

To the Editor of the Journal of Science.

SIR,—Although you ridiculed Dr. Richardson's opinion that the insane have a peculiar smell, perhaps the subject may be worthy of inquiry. I have been assured, by one who had means of observing, that nearly all the insane have a peculiar odour, which varies much in different patients, but which my informant thinks can be generally distinguished from other personal odours. May not disorders of the brain be associated with disorders of the excretions?—I am, &c.,

B.

[We think our correspondent will find, on re-examination, that our ridicule extended merely to the sensational language employed by Dr. Richardson.—ED. J. S.]

CUCKOOS.

To the Editor of the Journal of Science.

SIR,—A peasant assures me that he can tell the foster-parents of young cuckoos by their baldness. He says that the feathers of the head are worn off by the cuckoo when fed taking it into its gape.—I am, &c.,

HUGH BROWNE.

VOCAL SOUNDS.

To the Editor of the Journal of Science.

SIR,—Your last volume notices Faber's speaking-machine as uttering fourteen distinct vocal sounds, and combining them into any words in any language. The elemental sounds of English are usually reckoned at about forty. Better analysis reduces these elements of speech, just as it has reduced the elements of chemistry; *e.g.*, the elementary vowels are six, namely, *e*, *a*, *ah*, *au*, *o*, *oo*. I believe an harmonic octave *e* makes the difference between *p* and *b*, *t* and *d*, *k* and *g*, *f* and *v*, *sh* and *zh*, *s* and *z*, *th* in thigh, and *th* in thy; and this lower octave may be the "drone" of which you speak, and which is itself an element. Then come *l*, *r*, *m*, *n*, and *ng*, making, I think, ten elemental sounds in English. Then we must reckon the German *ch* (which survives in Scotland), the French *u*, and I think there is a sound peculiar to Polish, and other tongues supply other elements, How are these pronounced by a machine speaking only fourteen elements?—I am, &c.,

HUGH BROWNE.

Nottingham, August 28, 1881.

NOTES.

M. LEDOULÆ has forwarded to the Geographical Society valuable information concerning the tzétzé fly, of which a notice has already appeared in "L'Union Médicale." All travellers in equatorial Africa have had good reason to notice the destructive power of this insect, the sting of which is death to oxen, horses, asses, camels, and even to dogs. Dr. Kirk, British Consul at Zanzibar, has, at the present moment, a work in preparation on the tzétzé fly, which he considers to be one of the greatest obstacles to the civilisation of Africa. A curious fact has been noticed in the post-mortem examination of animals which have died from the effects of the tzétzé fly's sting—namely, that there is no lesion whatever of the spleen, liver, lungs, or brain. The symptoms causing death resemble those of glanders. It is supposed that this disease is infectious to animals of the same species.—*Medical Press and Circular.*

Speaking of the twenty-eighth Annual Report of the "Science and Art Department," the "Standard" happily says—"It is quite as bulky, as intensely official, and if possible more self-complacent than ordinary."

It is an error to assert that the fly now committing depredations in the olive-grounds of Southern France (*Dacus oleæ*) is a species not hitherto observed. It was mentioned forty years ago under the same name, by Prof. Westwood, in his "Modern Classification of Insects."

Prof. Huxley, in a Lecture delivered before the Medical Congress, asserts that "The essence of modern, as contrasted with ancient physiological science, appears to lie in its antagonism to animistic hypotheses and animistic phraseology."

Miss F. P. Cobbe has been throwing some more "broken light" upon vivisection, before an audience of lady dog-fanciers and sentimentalists at Edinburgh. Mr. D. McLaren followed in a similarly illogical strain.

We have this season fully confirmed the statement that the tomato plant is avoided by earwigs, caterpillars, aphides, the cuckoo-spit insect (*Aphrophora spumaria*), and even by slugs and snails. But it does not appear to have any protective influence upon other plants in its immediate neighbourhood.

M. H. Toussaint ("Comptes Rendus") has experimentally established the parasitical character of tuberculosis. He has

collected the microbia of the disease, and cultivated them artificially.

According to "Les Mondes," a manuscript work of Copernicus has been discovered in the Observatory of Stockholm. It was formerly the property of Helvetius.

M. C. K. Hoffmann ("Archives Néerlandaises," xvi., 2), in a memoir on the development of the *Plagiostomi*, notes the formation of the dorsal chord from behind forwards, in the cartilaginous fishes, as of importance from a phylogenetic point of view. This is in accordance with the fact that the anal aperture of Rusconi (aperture of invagination, or *Urmund*) originally marks the anterior extremity of the animal.

According to the official Mineral Statistics of Victoria, the yield of gold for 1880 exceeds that for 1879 by 70,173 ounces. The total yield of silver for the year is 23,248 ounces.

Crioceris asparagi is committing serious ravages on asparagus in France. Aniline hydrochlorate dissolved in water, in the proportion of 500 grms. per hectolitre, is used as a remedy.

Dr. C. Callaway, writing in the "Geological Magazine," considers the organic nature of *Eozoon Canadense* not proven.

Mr. W. Williams ("Geological Magazine") finds no evidence that the Irish elk, *Megaceros Hibernicus*, was extirpated by, or was even contemporary with, man. In no instance has it been found in the peat.

MM. D. Verbrek and R. Fennema ("Archives Néerlandaises") have examined the pre-tertiary deposits of Java, and report that in this island there occur many tertiary deposits and few ancient strata, whilst in Sumatra, and especially in the highlands of Padang, the reverse is the case.

Von Baumhauer ("Archives Néerlandaises") finds that true diamond, bort and carbon, differ respectively merely by a more or less perfect crystallisation, and pass into each other by insensible degrees.

MM. J. Künckel and J. Gazagnaire have studied the seat of taste in the Diptera, and sum up their results in a paper laid before the Academy of Sciences, to the effect that the seat of taste commences in the paraglossæ, is continued along the false tracheæ, is manifested more strongly at the extremity of the epipharynx, where there occurs a bunch of nerve-terminations, and comes to an end at the entrance of the pharynx.

In the "Revue Internationale des Sciences Biologiques" the Museum of Natural History at Paris is said to be dying of senile despotism and shameless nepotism.

A large zoological station is being constructed in the Parc des Princes, at Passy, near Paris.

The temperature in Norway during the last winter, from October, 1880, to March, 1881, has been 7° C. lower than the average. At Karasjok the lowest temperature registered, between January 13th and 18th, was −50·6° C.—a greater degree of cold than has ever been observed there before.

At Prague the thermometer descended to −15° C. in the first week of June, destroying numbers of swallows.

Dr. Sacc, of Montevideo, contends that rabies in dogs might be entirely prevented by increasing the number of females and decreasing that of the males.

According to M. C. Maze, on June 27th the temperature at Memel (22·9° C.) was the same as at Algiers, 19° farther south; and on the same day the thermometer stood higher by 5·4° at Ulleaborg, at the head of the Gulf of Bothnia, than at Paris.

L. Hervé ("Les Mondes") thinks that all species of animals, man included, are larger and more vigorous on calcareous than on siliceous soils.

The "Medical Press and Circular" considers that up to the present time "sanitation" has had no apparent effect in reducing the prevalence of certain diseases, more especially diarrhœa, diphtheria, and fever of typhoid type: the recent epidemic of smallpox further shows that the virulence of that disease has undergone no diminution whatever.

It is not generally known that the sense of smell may be made, for the time being, more acute by filling the mouth with very cold water.

According to Captain Vassel, the Nile, in the Diluvial epoch, discharged itself into the sea in the midst of what is now the Isthmus of Suez, gradually filling up the narrow and shallow strait which then connected the Red Sea and the Mediterranean. Meantime its great volume of fresh water served as a barrier between the salt-water faunæ of the two seas. The Amur at the present day forms, in the same manner, a barrier between the salt-water faunæ of the Sea of Japan and the Sea of Ochotzk, the former of which has a tropical and the latter an arctic character.—*Verhand. der K. K. Geol. Reichsanstalt.*

The water of the Dead Sea, according to the recent analysis of H. Fleck ("Repertorium Anal. Chemie"), contains per litre:—Potassium chloride, 16·9 grms.; sodium chloride, 74·051 grms.; sodium bromide, 5·024 grms.; magnesium chloride, 128·105 grms.; calcium chloride, 35·355 grms.; and calcium sulphate,

1·211 grms.; in all, 260·646 grms. of salts. The specific gravity, at 15° C., is 1·1861.

J. Brautlecht ("Virchow's Archiv. für Path. Anatomie") has detected pathogenic Bacilli in the urine of patients suffering from typhus, in suspicious waters, and on the surface of putrescent Algæ. He finds that, in contrast to non-pathogenic Bacteriaceæ, they possess no reducing power, and do not, *e.g.*, convert nitrates into nitrites. They were capable of cultivation in water containing gelatine and ammonium phosphate. If injected under the skin of rabbits they occasioned fatal fever, resembling typhus with abdominal complications.

According to the "Berichte der Deutsch. Chem. Gesellschaft," alantoine occurs in the vegetable organism.

Herr Probst ("Jahreshefte Verein. Naturkunde Würtemberg") seeks to account for the chief phases of geological climate without the aid of cosmic changes. He explains the uniformly high temperature of the Silurian, Devonian, and Carboniferous epochs by a predominance of sea, and by the assumption of constant cloudiness in high latitudes, with bright skies in the tropical regions. A denser atmosphere and a somewhat greater internal heat of the earth would be sufficient to account for the occurrence of reef-forming corals in Grinnel Land. The gradual increase of land accounts for the decreasing uniformity of climate, whilst the Glacial epoch is ascribed to the upheaval of lofty mountains in continuous masses at the end of the Tertiary period. The action of erosion gradually reduced the level of the mountains, and opened valleys in their compact masses, thus leading to the return of a milder climate.

H. H. Haworth ("Geological Magazine") contends that the mammoth "was extinguished by a sudden catastrophe involving a great diluvial movement over all Northern Asia, accompanied by an equally sudden and violent change of climate." A specimen of *Rhinoceros tichorhinus* has been obtained in such good preservation that the death of the animal can be plainly traced to asphyxia.

Numerically and financially speaking the late "Jubilee meeting" of the British Association at York has been most successful. The proceedings at the "Economical Section" would, however, have been much more suitable for a Chamber of Commerce. Unless the Committee see their way to the abolition of this Section, we fear the Association will gradually degenerate into a Political Discussion Society. For debates on "free trade" and "fair trade" there is ample scope elsewhere.

According to Prof. Winchell ("Popular Science Monthly") the copper miners of Lake Superior were the Red Indians, and no some distinct and antecedent race.

Mr. D. V. R. Manley, writing in the same journal, calls attention to the "midget," a minute yellow insect infesting the islands of Lake Erie. Like the chigoe (*Pulex penetrans*) of the West Indies, it has the habit of burrowing under the human skin, and setting up intense irritation.

M. F. A. Forel, in the "Archives des Sciences Physiques et Naturelles," maintains that the advance and retreat of glaciers do not depend on the amount of snow in the last winter, or on the higher or lower temperature of the summer, but on the periodic increase or decrease of snow-fall through a number of years. A periodicity of ten, twenty, or in some cases of more years, is observed in the alternate growth or decrease of each glacier.

According to M. H. Fayol ("Comptes Rendus") the fossil trees found in an upright position in the coal strata have not grown as they are found, but have been deposited by water.

Pflüger and Oscar Loew (Pflüger's "Archiv für Physiologie," xxv., p. 150) conclude that living protoplasm possesses in a high degree the power of reducing the precious metals from their solutions, but loses this property when dead. The phenomenon known as life is probably conditioned by those reductive groups of atoms—probably aldehyde groups.

M. Ph. van Tieghem ("Soc. Botanique de France," xxvii., p. 353) has observed, for the first time, fungoid vegetation in oil. One of the forms was incapable of cultivation in moist air, and could not be determined. The other was found very similar to *Verticillium cinnabarinum*.

According to Stebler ("Naturforscher," xiv., 332) light has a greater influence in promoting the germination of certain plants (grasses of the genus *Poa*, ferns, &c.) than heat.

The "Archives des Sciences Physiques et Naturelles" (ser. 3, tome v., p. 516) contains a very important memoir, by Prof. A. Agassiz, on the palæontological and embryological development of the *Echini*.

It is reported that the "Colorado beetle" (*Doryphora decemlineata*) has obtained a foothold in Belgium, near the French frontier.

A Curculio (*Phytonomus punctatus*) which has long been known in Europe, but has occasioned no injury, has, according to the "American Naturalist," made its appearance in the State of New York. It is doing much damage to clover.

According to the "American Naturalist" a certain Dr. Jones, of the Concord School of Philosophy, saith—"Of the idea of Evolution and of the origin of species, we must think some worthier thought than that of a monkey or gorilla rubbing off his tail, and otherwise improving his condition, until, through

natural selection of condition, he finds himself a spiritual being with an immortal soul." Might we remind this Dr. Jones that a gorilla has no more tail to "rub off" than a "Concord Philosopher"?

On the same occasion a Mr. Alcott held that, "instead of coming up from animals, animals have descended from men, and were possible only because man made himself a beast first."

Prof. His has, very characteristically, sought to deny the existence of a rudimentary tail in the human embryo. He denies the existence of supernumerary vertebræ in the "caudiform appendage." Prof. Gerlach has shown, however, in an elaborate memoir ("Gegenbaur's Morphologisch. Jahrbuch"), that such supernumerary vertebræ actually exist.

M. Emile Delaurier ("Les Mondes") considers that the excessive velocity of comets causes a vibration of the ethereal matter of space, and producing heat and light, and thus gives rise to the so-called tail. He contends that the popular belief in the influence of comets upon the temperature is not groundless.

According to H. C. Bumpus ("American Naturalist") the yellow-bellied woodpecker drinks the sap of the birch-tree. "The humming-birds were very thick round the tree, sucking the sap where it was running from the holes; there were also butterflies and moths around it."

[We have often captured Lepidoptera by boring holes in trees and seizing the insects as they came to drink.—Ed.]

Dr. C. Brame ("Les Mondes") maintains that cyclides and cyclidary formations appear general in nature, not merely in organic matter, but in plants and animals, of which he gives instances. He argues that the chemical law of multiple proportions is applicable to the relative dimensions of the central object and of the cyclide or the concentric cyclides.

H. C. Heller ("Wiener Akad. Wissenschaft") observes that genuine Alpine forms show a strong tendency to melanism. *Lacerta crocea* and *Polias prester* take in the higher mountains an almost black colouration. The mountain salamander (*Salamandra atra*) is intensely black. The fish in the Alpine lakes have dark colours. With the exception of the Chrysomelidæ most of the insects are black or deep brown, and the higher we ascend the darker become their colours. This is the more interesting as the Alpine flora is distinguished by the brightness and purity of its colours.

According to "L'Union Medicale" a crucial experiment on M. Pasteur's system of protecting cattle from anthrax, by a kind of vaccination, was performed in May this year, near Melun, and was attended with complete success.

Mr. Herbert Parsons, writing in the "Medical Press," observes that "the immediate effects of opium are far more pleasant and perfect than those of alcohol, while permanent injury to the system is not so certainly a final result."

M. G. Delaunay submits to the Academy of Sciences certain interesting results on the action of strychnine, applicable in part to that of other poisons. He finds that of two frogs, the one large and vigorous, and the other small and feeble, the former is more severely affected by an equal dose of strychnine. A well-fed frog is more susceptible to the poison than one which has fasted for some weeks. A frog which has been walking and jumping suffers more severely than one which has been at rest. A frog fixed with its head upright is less strongly attacked than one placed in the reversed position. He remarks that the bite of a viper has little effect upon a dog when at rest, but is rapidly fatal if he is fatigued with hunting, &c.

The existence of fossils in meteoric stones has excited much discussion, and is said to have been admitted by Mr. Darwin. According to "Science" the Helmholtz-Thomson hypothesis, of the origin of life on the earth, has become a tangible reality. (But supposing that fossilised organisms have reached the earth from the realms of space, does it follow that living organisms have been also thus transported?)

The "Medical Press and Circular" maintains that the cases of irreparable injury received in schools from corporeal punishment are beyond number. (How is it that none of our humanitarians feel called upon to interfere?)

According to an analysis of Prof. Frankland the water of the Holy Well of Zemzem, at Mecca, is sewage more than seven times as rich as the average sewage of London.

At the Cincinnati meeting of the American Association for the Advancement of Science, C. S. Minot endeavoured to show that man is not the highest animal. We shall examine this paradoxical memoir on a future occasion.

M. Axel Blytt ("Botanische Jahrbücher für Systematik u. Pflanzengeographie") concludes from the facts of organic geography, that the temperature of the sea and the strength of oceanic currents are subject to periodic changes. He finds in the distribution of the various groups of the Norwegian flora evidence that dry periods with a continental climate, and moist periods with an insular climate, have repeatedly alternated since the ice age. He considers that the study of these climatic changes will show that the distribution of species follows laws as simple as those manifested in the revolutions of the planets.

Mr. J. W. Stephenson considers the swinging sub-stage of comparatively little value, as it is unable to utilise the full aperture of the modern homogeneous immersion objectives: this can only be done by means of immersion illuminators, which are used on the ordinary rigid sub-stage arrangement.

Dr. H. R. Rogers ("Progress of Science") considers the sun not "the manufacturing place and distributing reservoir of actual light and heat," but "the source whence the whole solar system is supplied with the invisible potential light and heat which become developed where required." The great central orb may therefore be regarded as like unto the earth on its surface and in its surroundings, viz., a dark, cold, habitable body.

The newly-invented instrument, by means of which the exact position of the bullet in the body of the late President Garfield was supposed to be traced, must of course fall into discredit now the autopsy has shown that its indications were erroneous.

It is reported that M. Pasteur is about to visit the Bordeaux lazaretto, in order to make a special study of yellow fever, and determine whether it is due to a parasite, and if it can be prevented by a kind of inoculation.

"Il Progresso" considers that sulphuric acid is slightly volatile at ordinary temperatures.

Dr. Alcott, of the "Concord School of Philosophy," pronounces matter "a precipitate of thought"—whatever that may mean.

According to "L'Union Medicale" the ancients employed electricity as a therapeutic agent, making use of a living torpedo (*Raia torpedo*) as a source of the agency.

A Sanitary Congress has been opened in Vienna.

Signor O. Comes ("Atti della R. Accademia dei Lincei") has published the results of his investigations concerning the influence of light upon the transpiration of plants. He finds that the emission of watery vapour from a plant depends not merely on the agencies which influence the evaporation of water from an open surface, but also on the action of light, and consequently reaches a daily maximum shortly after noon. In case of a coloured organ only those rays of light are effective which are absorbed, and not those which are reflected.